AMATEUR WORK

A MONTHLY MAGAZINE OF THE USEFUL ARTS AND SCIENCES

Vol. IV. No. 12. BOSTON, OCTOBER, 1905. One Dollar a Year.

MODEL MAKING FOR AMATEURS.

PROPOSED SOCIETY OF MODEL MAKERS.

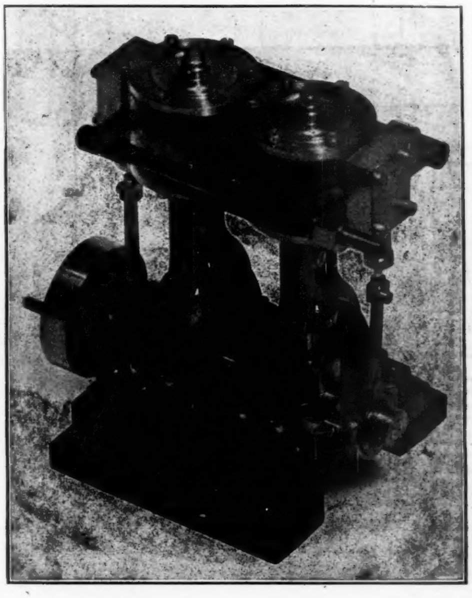
The accompanying photographic view and drawings illustrate one of several small models obtained by Mr. Parsell of Parsell & Weed, New York, during a recent visit to England. His collection is a very interesting one, as it includes both single and double vertical and horizontal engines, several types of feed pumps, and other accessions, required for the proper operation of the models, all of which are accurate representations of their large prototypes, so far as mechanical requirements will permit. The engine here illustrated is about 5 in. high and 5 in. long, the drawings showing each piece the full size. All the parts are of brass, except piston rod and shaft, crank shaft and crank. All the work is exceptionally well done, so that the friction of bearing and glands is but little.

The ease with which the crank turns is surprising, and with a proper boiler the engine will undoubtedly develop power enough to drive a 3½ or 4 ft. model steamer, although no tests have been made by Mr. Parsell to ascertain the actual power it will give.

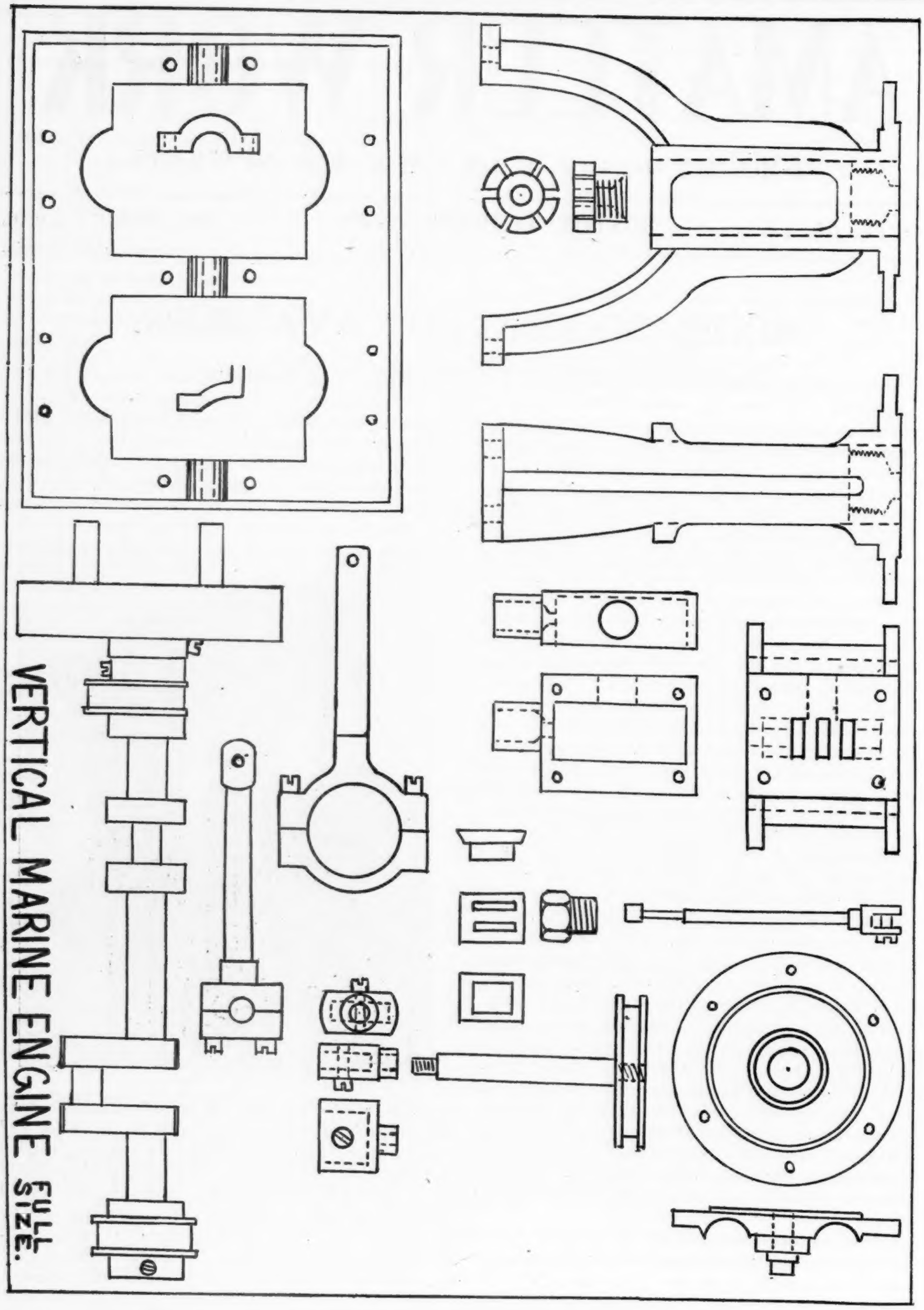
An inspection of the various parts, when taken apart shows nothing in their construction which should be found at all difficult by the mechanic of ordinary skill, keeping in mind, of course, the necessity of being accurate with all fits. For this reason the adaptability of such models for construction by amateurs, and especially senior pupils in manual training schools, makes it worthy of their careful attention. Such work is very popular in England, where model enthusiasts are organized into a very popular and beneficial society, known as the "Society of Model Engineers." This society has numerous branches, holds regular meetings and exhibitions at which valuable prizes are offered for models of various kinds. A "Junior Branch" gives suitable opportunity for beginners and the younger class, who have not reached the proficiency and experience of the members of the regular society.

As the educational benefits to be derived from work of this kind are considerable, and contribute directly to practical results of importance, the desirability of increasing the interest in this country is worthy of attention.

Undoubtedly there are many readers of Amateur Work, who would be glad to take up work of this kind, if assured that designs, castings and the neces-



sary construction information would be forthcoming. Let those who are interested write to the editor and express such interest, adding also any suggestions that may come to mind. If a sufficient number should desire, an "American Society of Model Makers" could be organized, and the editor of this magazine may be counted on to give all the assistance towards making it a success, which lies in his power. Such a society, however, cannot be made of interest and value to


VERTICAL MARINE ENGINE
FULL SIZE.

its membership, unless those constituting it are willing to attend meetings, canvass for new members, participate in competitions and exhibitions, and do all they can to start the society in a manner which will make it worthy of the attention of capable and ambitious mechanics. If the idea of such work and such a society appeals to you, take the time to write and say so at an early date so that the organization may be started, and the winter devoted to placing it upon a sound and permanent foundation.

WAVE LENGTH IN WIRELESS TELEGRAPHY.

OSCAR N. DAME.

Since it has been determined that the velocity of all etheral waves is the same, practically, it may be noted that the length of each wave varies inversely with the frequency.

To explain this more acceptably to the average reader let us consider a rod of steel held in a vise at one end and strike a sharp blow. The rod will vibrate at a frequency depending upon the length of the rod. The frequency of vibrations under varying length of rod is noted by the higher or lower pitch of sound.

In the case of the vibrating rod, the period of vibration will be the same at all parts of the rod, and the amplitude will vary from nothing at the fixed end to a maximum at the free end.

Similarly, if a wire having one end insulated while the other end is held at a constant potential by earthing the end, be struck an electrical blow, electrical oscillations will be set up in the wire, the frequency of which will depend entirely on the length of that wire, while the amplitude will vary from nothing at the earthed end to maximum at the free end. In this case amplitude of oscillation is the alternating potential.

If we had struck the steel rod a series of light blows accurately timed, the same amplitude of vibration could have been obtained as by the single heavy blow, but these blows must be properly timed.

Because of the oscillating nature of an electrical spark it is not feasible to erect a wire in the air and operate by means of one solitary spark-crash, so to get the same results in radiating effect, the frequency of the oscillating "blows" must be suited to the natural frequency of the wire.

This accord of spark frequency with aerial wire is called "resonance." When perfect resonance is obtained by having just the proper length of wire in use to harmonize with the spark oscillations in use, the aerial wire vibrates freely and sets up an electrical disturbance in the ether, which experiment proves to be proportional to the length of the aerial wire. It will therefore be seen that one might have a wire hundreds of feet into the air, and if the other factors did not harmonize, the results would not be as satisfactory as when a much shorter wire is used.

In a plain aerial installation, one secondary terminal of the coil is connected to one knob of the spark gap to the aerial wire; the other terminal to the other knob of the gap and to the earth.

By proper choice of length of aerial wire suited to the electrical properties of the coil and spark gap, a degree of resonance may be obtained, but the capacity of the aerial wire is comparatively small, hence the small quantity of electricity set in oscillation, while the resistance of this open circuit with a spark gap in series is very high, therefore the oscillations die out quickly because of this dampening, and the form of wave produced by a single charge from the induction coil is

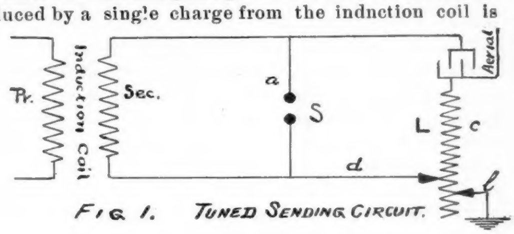


FIG. 1. TUNED SENDING CIRCUIT.

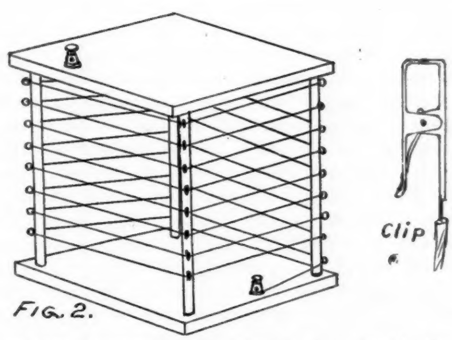


FIG. 2.

neither harmonic nor calculated to break down the distant coherer as required. In other words, a circuit as just described is purely experimental and not of value in sending signals by the dot and dash method over any great distance.

In the closed circuit installation, as shown in Fig. 1, the coil charges the Leyden jars until the potential is sufficient to jump across the spark gap. Then an oscillating current is set up between the coatings of the jars through the induction *L*, and the spark gap *S*, by way of *d*. Owingto the amount of capacity of the jars and shortness of the spark-gap, the oscillations are well sustained. The aerial wire is attached to the point *s* and the earth at *E*, and the open radiating circuit is

aerial wire through L to earth E. It will be noticed that induction L is common to both open and closed circuits, and if the open circuit is brought into resonance with the closed circuit, an oscillation will be set up in the aerial wire which will be well sustained by the heavy oscillation in the closed circuit. The reader should trace out these open and closed circuits on the diagram so as to fully comprehend the text, for this theory of balanced and harmonized circuits appears in nearly every system of wireless telegraphy.

The train of waves set up by one discharge of a coil through this circuit rises after a few oscillations to a maximum, remaining there some time, and then dies out. Their effect on a suitably constructed receiving aerial properly belongs to another article which will appear in a future issue of this magazine.

In constructing the tuning coil for sending, a great deal of latitude may be given in the choice of materials and their arrangement for use. One coil, which the writer has seen in use for some months, is of the bird-cage pattern, consisting of four upright strips mounted on a base board.

Following are the specifications as given by the builder: Four pieces of birch dowelling 3 ft. long and 1 in. in diameter; two pieces of whitewood or pine 10 in. square and 1 in. in diameter. In the corners of each square were bored 1 in. holes and the dowels fastened therein securely with glue. This forms a framework much like a hollow cage. Some very small screw eyes with holes just large enough to carry No. 12 bare copper wire were screwed into the corner posts on the outside, commencing at the bottom and continuing to the top at equal intervals of one inch. Into the bottom baseboard was fastened a large binding post to which was soldered the first terminal of the coil. Continuing, the wire passes through the screw eyes in coil or spiral form until the last one at the top is reached, where the end is also affixed to a binding post. All the woodwork is heavily shellacked. The flexible wire "*d*" which comes from one of the coil discharge knobs, has a metal spring clip, like the ordinary suspender clasp, on the free end, as does also the flexible wire "*t*" connected to the earth. With these clips any portion of the coil may be brought into use and any changes readily made, the coil, of course, being shut off while this is being done.

NEW EDISON BATTERY A SUCCESS.

Thomas A. Edison makes the important declaration that he has at last solved the problem of providing cheap and serviceable storage batteries for vehicles. He is quoted as saying: "By October my light battery will be ready for the market and we will be ready to equip automobiles of all descriptions. To reach a definite conclusion of its possibilities, I manufactured 11,000 cells and equipped about 160 conveyances. In Washington we attached the batteries to a number of express delivery wagons, with the result that after many months the cost of operation has been found to be 58 per cent that of horses. The batteries manufactured varied in types, so that I might obtain the happy average I wished to strike, and I am prepared to make the unqualified statement that the Edison battery will revolutionize the storage battery problem. As to its power there can be no question. I had a big two-ton car brought to my factory in Orange, where it was fitted with cells, and we took it out and sent it over the roads of New Jersey at 33 miles per hour."

MAGNETIC PROPERTIES OF ALLOYS.

At a recent meeting of the Royal Society of England J. A. Flemming and R. Hadfield gave the results of some of their investigations on the magnetic properties of alloys. They have found that an alloy composed of manganese 22.4 per cent, copper 60.5 per cent, carbon 1.5 per cent, silicon 6.37 per cent aluminum 11.05 per cent and iron 0.21 per cent, has magnetic properties which are identical with those of materials which are naturally feebly magnetic and that the permeability is between 28 and 20, which is not much inferior to the values reached for a low grade of cast iron for small magnetic forces. The alloy can also be permanently magnetized. This leads to the surmise that the magnetic properties of the alloy result from a similarity of molecular structure to that of the ordinary magnetic materials, such as iron, nickel and cobalt, and that, if the proper molecular arrangement can be found in an alloy, it may be possible to construct a material which is quite as magnetic as iron, and possibly even more so.

NEW ARMOR PLATE MILL.

The successful test of the first lot of armor plate made by the Midvale Steel Co., is a master of more than common interest. It has been generally held that it was idle to expect the discovery of any process capable of producing such plate of a quality equal to that of the established manufacturers, says the "Engineering Record." Even if such a discovery were made, the probability that it could become commercially successful so that large deliveries could be made on time was considered still more problematical. The event leading to the recent tests at Indian Head show that not only is the Midvale Co. able to make good plate, but is also able to turn it out on time, and it is important to recall in this connection that the company's contract was taken at a considerably lower figure than the prices in the tenders of the Carnegie and Bethlehem companies, which have heretofore had a monopoly of the business in the United States.

PHOTOGRAPHY.

PORTRAITURE INDOORS.

I am sure I do not know why, but one of the first an amateur attempts to do is to take a portrait. Sometimes he is successful and gets something that pleases his sitters, and sometimes he does not—more often the latter.

Now, indoor portraiture is one of the easiest things imaginable if one goes the right way to work. Our best photographers have studios beautifully equipped with blinds, etc., but very often they block out most of the light, and have only as much—sometimes even less—than an amateur can get in an ordinary room. It is the use of the light that is the secret, and not the after manipulations of developing and printing. If a beginner were given an undeveloped plate exposed by a professional he would perhaps get as good a negative as the more experienced man. It is in the lighting of the sitter that the beginner errs. Let us then look into it, and to do so properly a diagram must be used.

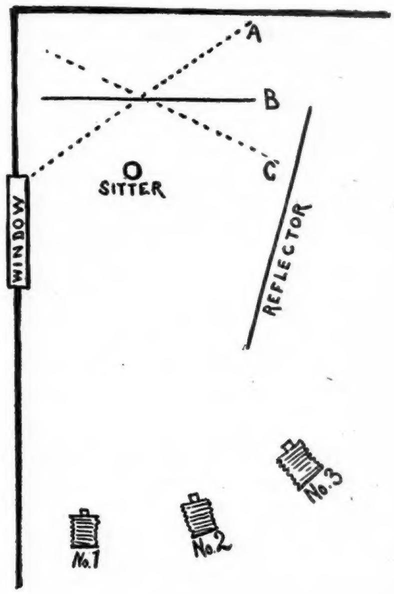
The sketch shown is meant to represent an ordinary room with one or more windows, but as we only require one window the others must be darkened, as the lighting from several windows will confuse us, and give cross lighting. The usual way of going to work is to place the background as *B* and the camera in the position marked No. 2. The background for portrait busts should be of medium tint, and different shades may be secured on this one background by placing it at various angles to the window, as shown in the dotted lines, *A* and *C*.

Now, if the camera be placed at No. 1 and we focus the sitter, what do we see? Simply that we have all the light on one side of the face and none on the other, and this is exaggerated upon the negative. The dry plate seems to increase the high lights and to deepen the shadows, and, although we may with the eye be able to see all details in the shadow part of the the face, the dry plate would have to receive a fairly long exposure, and the light side of the face would be blocked up owing to the gross over-exposure it would receive.

What we have to do, then, is clear; we must diffuse the light, take some from the light side of the face and use it on the darker side. This is easily accomplished by means of reflectors and screens, all of which may be home-made.

We may start by placing a reflector made of white paper or a sheet somewhere about the spot shown on the diagram. It matters little of what material the reflector be made, as long as it serves its purpose. Some workers use a large mirror, but this does not diffuse the light enough. So far so good, and this is the point at which most amateurs arrive and then fail. Why?

Simply this. There is still too much light on the window side, and it should be diffused. This may be done by means of tissue paper pasted over the lower half of the window, or better still, the dodge recommended by Richard Penlake in his book on the subject. Get a large wooden hoop, such as children use, and cover it with one thickness of tissue paper. Attach this to the bottom of the blind, if there be one, and by raising or lowering the blind we may get almost any quantity of light and shade we require. It is the working of this diffuser between the window and the sitter that is the great secret of home portraiture. Having got this window screen to work, the rest is simple. By placing the camera at 1, 2, or 3, and the background at *A*, *B* or *C*, it is possible to secure lighting equal to some of the best studios. The position of the reflector, too, can be varied.



Be careful to have enough light to light up the lower part of the face, either by carrying the reflector low down, by a sheet of white paper on the floor, or by manipulating the window screen. Focus the eyes, use as large a stop as possible, give a full exposure, develop carefully, and aim for a soft negative. Your indoor portraits should then be a success.—"Photo American."

PHOTO'S ON WATCHES AND THE LIKE.

There is evidently a growing taste for photographic portraits on such articles as watches, gold or silver cigarette cases, match boxes, etc., and the jewellers who undertake to get this class of work done usually charge a pretty good figure for it.

As the carbon method of producing pictures of this kind may be of service to many of our readers, we shall assume at once that the reader is already quite familiar with the practical working of that process, for we here say that anyone who takes up the working of this process for the first time and attempts to apply it to the present purpose, must not expect to meet with any great success in his first few essays. It goes without saying, that it is the double transfer system that must be employed—the picture being developed on a temporary support, and then transferred to the article desired. It will at once be seen by practical workers that the ordinary commercial flexible support is not suitable for the reason that it is too thick and unyielding to be pressed into sufficiently close contact on a convex surface, such as the dome of a watch-case, for example, to obtain a perfectly finished transfer. It may, however, sometimes be successfully used for quite cylindrical articles.

For the above reasons it will be obvious that a more flexible and yielding support must be employed. One is the India rubber support as first used by Swan; another is a film of collodion. We will deal with the former first. Some thin "foreign post" paper, the thinner the better, so long as it will withstand the warm water in the development, is coated with a solution of India rubber about the consistency of thin treacle. The best way of obtaining this is to get a tin of solution from the rubber stores and thin it down with benzole to the required consistency. It is poured into a dish and the paper floated upon it and then hung up for the benzole to evaporate. The paper had best be coated a few days before it is required for use, so as to ensure that all the solvents of the rubber have thoroughly evaporated.

This India rubber support is used in precisely the same way as the ordinary flexible support, the exposed tissue is squegeed upon it, developed, and then allowed to dry. The picture need not be alumed; indeed, it will be better for our present purpose if it is not. The picture is now ready for transferring to whatever may be required, which for the moment, we will assume to be the dome of the watch-case. It is unnecessary to mention that it must be removed from the watch; this a neighboring watchmaker will do for one. The dome is then cleaned with benzole, to remove all traces of grease or dirt. It is then coated on the outer side with a solution of gelatine containing a little chrome alum, such as that used for double transfer paper. The following is a good formula to employ:

Nelson's No. 1 gelatine	½ oz.
Water	10 oz.
Chrome alum dissolved in 1 oz. of water	6 gr.

The dome is evenly coated with this and allowed to dry. To make the transfer neatly, trim the print to the required size and put it and the watch dome in cold water for ten minutes or so. Next, put the latter in warm water at about 105° to 120° Fahr., until it just feels slimy. Then take the print, having previously marked it as a guide to position, and put it into contact with the dome, of course avoiding air bubbles, and remove the two and press in close contact with a soft dry handkerchief, gently rubbing towards the edges with the fingers so as to remove all superfluous water. It is then allowed to become thoroughly dry spontaneously. When dry the back of the paper is moistened with benzole, and after resting for a minute or two the paper can be slipped off, leaving the picture firmly attached to the metal. It now only remains to varnish the work. This may be practically a cold lacquer, and when dry is hard and durable as is the lacquer on our lenses. It is simply flowed over and drained off, and it dries in a few hours.

We mentioned just now that collodion might be used as a temporary support, and perhaps on the whole it is the best to employ. Here is the method: A glass plate, after being waxed, or prepared with French chalk, is coated with ordinary enamel collodion, thickened with two or three grains per ounce of pyroxiline, so that it yields a thick film. After the collodion has thoroughly set, the plate is put into a dish of water to soak, and is afterwards washed under the tap to get rid of the solvents of the collodion. The exposed tissue is then squeegeed on that, developed in the ordinary manner and allowed to dry. When dry the film can be stripped off and trimmed and then mounted on the metal, as just described. It is a good plan to trim the picture while it is still on the glass—a wheel trimmer and zinc shape is convenient for the purpose. The collodion film has an advantage over the rubber support, inasmuch as it is transparent, so that air bubbles can be seen and the picture better arranged in position. After the transfer the cellodion can be dissolved off with a mixture of ether and alcohol.

In conclusion, it may be mentioned that for carbon pictures on metal a tissue should be selected that contains a large proportion of pigment to gelatine, and should also be printed from a tolerably thin negative, so as to avoid a high relief in the image, which is objectionable in this class of picture, and, moreover, it serves to indicate the method by which it has been produced, which, in some instances, it is not desirable to do.—"British Journal."

According to a contemporary, a square foot of uncovered pipe, filled with steam at 100 lb. pressure, will radiate and dissipate in a year the heat obtained by the economic combustion of 393 lbs. of coal. Thus, 10 square feet of bare pipe corresponds approximately to the waste of two tons of coal per annum.

FACTS CONCERNING PATENTS.

A Paper read by Mr. F. W. Winter befo.e the Mechanical Section of the Engineers Society of Western Pennsylvania.

CONCLUDED FROM THE SEPTEMBER NUMBER.

Several Claimants for Same Invention.—It is never absolutely certain that a patent can be obtained until it is actually granted. Several parties may apply for a patent on the same invention, and in that case the applications will be put in what are known as "interference" proceedings, in which the parties will be required to take testimony to prove who is the first inventor, and the patent will be granted accordingly.

The first inventor is the person who first perfected the invention and put it into a form capable of actual use, or, as it is technically known, "reduced the invention to practice". The best evidence of a completed invention is an actual commercial use thereof. But there is a rule that the filing of an allowance application for patent is the "constructive reduction to practice" and has the same force and effect in a contest on priority of invention as an actual commercial use.

While the general rule is that the first inventor is he who first reduced the invention to practice, an exception is recognized in favor of the party who was the first to conceive of the invention but the last to reduce it to actual practice, providing he was using reasonable diligence in perfecting and adapting the same. What constitutes reasonable diligence depends upon the particular circumstances of each case. The means at the command of a person, his employment, and other surrounding circumstances, his health, the complication of the invention, and cost of perfecting it, are all factors which enter into this question. What the law requires is reasonable and not the utmost diligence. But the Patent Office does not look with favor upon delays, and it requires a good excuse in all cases. The theory is that the party who first adapts an invention for actual use should not be barred by the stale claims of a prior conceiver who had slept on his rights.

The Patent Office does not require mechanical perfection, but will allow an application which shows a theoretically operative device and clearly describes the principle thereof. Since the filing of such an allowable application, in a contest of priority of invention, has the same force and effect as an actual use of the device, it is advisable for inventors to make application as soon as they have theoretically perfected the invention and not wait until they can put it into actual use, unless, of course, they are so situated that they can speedily give the invention an actual test.

Even after a patent is granted another party may file an application for the same invention and be put in interference with the patent. If he is able to prove by evidence which does not admit of a doubt, that he first completed the invention, a patent will also be granted to him. The Patent Office, however, cannot call back or annul the patent first granted. It will merely be decided that the patentee was not the first inventor and a patent will be granted to the applicant.

The Patent Office has no jurisdiction over a patent after it is granted except to declare an interference between it and a subsequent application, or to grant a reissuance of the patent in case it is invalid or inoperative by reason of a defective or insufficient specification.

Patent Does Not Guarantee that Invention Can be Used.—The grant of a patent is no indication that the device covered thereby can be used without infringing prior patents. This is a point upon which much misunderstanding exists. Many persons assume that because the Patent Office grants a patent, the patentee has a perfect right to use the device covered thereby. This is an error. The Patent Office does not pass upon the question of infringement, but merely decides whether the applicant has made a patentable improvement over prior devices, and it frequently happens that there are still in force prior patents which cover fundamental principles of the device, and which will be infringed by the improved device, if the latter performs the same function by the same or equivalent means. To illustrate:

The original Bell Patent covered the fundamental principles of transmitting speech electrically. Within a few years thereafter, and during the life of that patent, others invented and patented many different forms of transmitting which were improvements upon the transmitter shown in the Bell patent. These improvements were clearly patentable; but they were just as clearly infringements of the Bell patent, because they of necessity operated on the principle covered by that patent.

But in many arts today the existing patents are limited to such specific improvements that other improvements do not infringe.

All patents are prima facie valid. They may, however, be invalid for many reasons. The examiners in the Patent Office are human and liable to error. They also have not available the material for all the grounds upon which a patent might be refused or invalidated. Patents can be refused upon publications or descriptions of the invention in scientific and technical journals or books in all languages. The Patent Office has not files of many publications, and many which they have are not available within the limited time in which the examiner must dispose of a case. So, too, a patent

may be refused upon a prior use of the invention in some remote part of the United States, and which may be known to only a limited number of persons. Obviously the Patent Office is not in a position to know of all uses.

There are, therefore, many elements entering into the validity of a patent upon which the Patent Office passes no opinion. A more extended examination through periodicals and prior uses than is possible for the Patent Office to make, will frequently show, either that the patent is entirely void, or that it must be so restricted that infringement can be avoided.

Who May Obtain a Patent.—It is essential to the validity of a patent that it be granted on an application signed and sworn to by the original and first inventor or inventors, or his or their executors or administrators. No other person, even with the consent of the inventor, can sign or swear to an application that will support a valid patent. The Patent Office has no means of ascertaining these facts, and will necessarily be governed by the oath of the application. Should it, however, afterwards develop that the party making the application was not the inventor, the patent will be invalid.

The fact that a person furnishes capital, machinery or material for developing the invention, gives him no right to make or join in the application for patent. Such person may acquire an interest under the patent, but this can only be done by an assignment executed by the inventor and transferring to him the whole or any fractional portion of the entire right to the invention and to the patent. If such an assignment is recorded in time the patent will be issued to the assignee, or jointly to the assignee and the inventor, as the case may be.

The builder of a new machine or device is not the inventor if he did not himself originate the ideas or principles contained in such device. In other words, an inventor may employ others to construct and mechanically perfect his invention without losing his exclusive right thereto, and without giving the mechanic who constructs it any right to the patent, unless it has been agreed upon by contract between the two parties. Even in that case the mechanic will take his right only by reason of the contract and under a properly executed assignment.

If a person conceives the general plan of an invention and employs another to construct and perfect the same, and the latter under such employment originates improvements which are included in, or, as the court said in one case, an ancillary to, the general plan, such improvements nevertheless belong to the person furnishing the general plan and can be included in any patent for which he may apply.

All patents and patent rights can be assigned without restriction by the owner or owners thereof, either before or after the patent is granted, or even before the application for patent is filed. All such assignments must be executed by the party or parties who have the legal title to the invention at the time the assignment is made. An assignment may cover the whole right under the patent or any fractional portion thereof.

An assignment must be recorded in the Patent Office within three months after the execution thereof. Otherwise it will be void as against subsequent purchaser for a valuable consideration and without notice of such assignment.

Patent Rights between Employer and Employee.—Employees as well as employers are entitled to their own inventions and to patents granted therefor. This right can be modified by contract, but in the absence of a contract to the contrary an employee is entitled to a patent for any invention which he makes, even though it may relate to the business of his employer. If he develops the invention in the time, and at the expense and with the tools and material of his employer, then the latter will have an implied license or shop-right to use such invention in his business, but he cannot demand an assignment of the patent.

Employers who wish to secure inventions relating to their own business, which are made by others while in their employ, should have a contract with the employee. Even with such a contract the employer cannot apply for a patent in his own name, but the patent must be applied for by the employee and assigned to the employer.

Joint owners of Patents.—Patents may be owned jointly by two or more parties, and these may have different fractional interests. A common misapprehension is that one joint owner of a patent may make, use or sell the patented invention without the consent of, and without accounting for profits to, his co-owners. This is an error. In the absence of a contract to the contrary, any co-owner of a patent, no matter what fractional interest he may hold, is free to assign his interest in the patent, or to manufacture, use and sell the patented device, or license others to do so, without the consent of his co-owners and without accounting for any part of the profits.

If, therefore, a person owns merely a one-hundredth share of the entire patent right, he may manufacture, sell or use the patented device without the consent of or accounting of the profits to, the owners of the other ninety-nine one-hundredths. By reason of superior facilities for manufacture or superior business ability, he may even monopolize the field so as to practically exclude his co-owners from deriving any income whatsoever from their share of the patent. He is nevertheless entirely within his right. The only way this can be prevented is by a properly drawn contract between the co-owners.

Applications for Patents.—Only a small percentage of patent applications are allowed as first filed. Generally the officials find some objections against the specifications or claims, generally the latter. It frequently happens that a patent is not secured until after repeated considerations. An inventor should

therefore not be discouraged because in the first instance his application is rejected. The rules give ample opportunity for overcoming rejections either by amendment or argument, or both, or even appeal to a higher tribunal.

Amendments may be made to applications at any time prior to the allowance, so as to more clearly or definitely claim the invention, or restrict the specification and claims to that which is found after examination to be new. But no new or additional matter can be incorporated in an application after it is filed. Anything which is found either in the specification, claims, drawing or model as originally filed in the Patent Office, is not new matter, but anything outside or beyond these will be refused, or if added, the patent will be invalidated thereby. This rule is very strictly followed.

The writer desires to emphasize this point, as his experience is that many inventors think that references which the Patent Office cite against their application can be evaded by making changes or alterations in, or additions to, the application. All efforts in this direction are futile. Modifications and alterations which come within the scope of the claims allowed in the application are covered and protected by the patent. But all other alterations or modifications are not protected by the patent. If they are of sufficient importance to constitute an independent invention, they can be protected by making a separate application therefor.

Marking Patented Articles.—The owner of a patent must mark the patented articles plainly with the word "patented," or similar word, together with the date of the patent, or otherwise give sufficient notice to the public that the device is patented. The failure to so mark will prevent the recovery of damages for infringement occurring prior to actual notice of the patent to the infringer.

No person should mark an unpatented article with the word "patent" or other designation which would lead the public to believe that the article is patented. For each such false marking, with intent to deceive the public, the marker is liable to a penalty of $100. While the application is still pending the manufactured article can be marked "patent pending" or "patent applied for." This will warn the public, and in most cases will prevent infringement.

Caveat.—There is a common misapprehension that a caveat is a short-term patent. On the contrary, it is a mere notice to the Patent Office that the party has made an invention and wishes further time to mature the same. It continues in force for one year and it may be renewed from year to year by the payment of the required government fee. If during the term of the caveat, or any renewal thereof, another person files an application for patent for the invention shown in the caveat, the caveator will be notified thereof and will be required to file his application within three months from the time of receiving the notice. The two applications will then be put in interference and testimony will be taken to prove who was the first inventor and the patent will be granted to such party.

A caveat is not a patent at all, nor even an application for a patent, nor can it by any possibility mature into an application. No one can be sued for infringement under a caveat. It is a mere notice to the Patent Office, and if the caveator wishes afterwards to obtain a patent he must file a regular application in the usual way.

Foreign Patents.—The patent laws of no two countries are the same, and a device which is patentable in this country may not be patentable in foreign countries, and vice versa, devices which are not patentable here may be patentable in some foreign country. In Germany it is difficult to obtain patents, the laws and their interpretations being very strict. Many of the small improvements which are patentable in this country find no favor under the German law. In other foreign countries, notably Belgium and France, no examination into the novelty or patentability of the invention is made, but the patent is granted as a matter of course. But this does not mean that the patent will be held valid, as it may be overthrown if it is found that the invention was not new in that country at the time the application was made. It is essential, therefore, in these countries that the prior state of the art be thoroughly investigated before the patent claims are drawn.

The cost of obtaining a patent in most foreign countries is greater than in the United States, and the conditions of maintaining the patent are somewhat burdensome. In this country, no taxes or renewal fees are necessary, nor is the patentee even compelled to manufacture the patented device or put it into use. In most foreign countries the patents are subject to annual taxes or renewal fees. These vary in the different countries, being generally quite low the first few years of the patent term, but gradually increase. Such taxes amount to a considerable sum in the aggregate, and if the patent is not producing a revenue they are a burden.

So, too, in most foreign countries the inventor must put the invention into actual use in that country, or at least make such arrangements for manufacturing and so advertise the fact, that any person wishing to procure the patented article can be supplied. The manufacture of the articles in this country and importation into foreign countries does not comply with this provision of the laws of those countries.

In most foreign countries patents must be applied for before corresponding patents are issued in this or any other country. Canada is an exception, as patents can be applied for within a year after the issue of a patent in another country.

THE DESIGN AND CONSTRUCTION OF INDUCTION COILS.

BASIL GRAVES.

It has occurred to me that not a few of our readers would appreciate a brief contribution upon this subject in general, if I may be permitted to judge from the number of queries dealing with the matter which have been reiterated during the past twelve months. The induction coil is one of those modern appliances now of more than mere theoretical interest, so numerous are its applications, not to mention the numberless instances where its use is necessitated. Not a few instances conducive to its universal use are afforded in the method of igniting the explosive charge of internal combustion engines, its utility in radiography, and, to a certain extent, electro-therapeutic work. Nor must we omit to consider the value of a coil as far as work in experimental research is concerned. It constituted the key to the innumerable experiments conducted by Hertz in his endeavors to solve the problem of the Berlin Academy of Science— viz., to establish experimentally any relation between electromagnetic forces and the dielectric polarization of insulators. The investigations which he pursued with a view to effecting this purpose resulted in the discoveries which, I need scarcely say, laid the fundamental basis of that modern application of the effects of electric oscillations—namely, wireless telegraphy. Here again the induction coil becomes of paramount importance; it constitutes the very heat of the apparatus employed. In spite, however, of these facts, the induction coil has continued to remain, comparatively speaking, an expensive piece of apparatus. Perhaps, from the manufacturer's point of view, I am not justified in making such a statement, for it certainly is to be confessed that the requisite time and trouble entailed in the construction of coils—especially with regard to those of the larger type—is considerable. But there are many who, given the means wherewith to proceed, and the necessary time, prefer themselves to attempt the work of construction. It is to these persons individually that the purchased article appears so expensive, and to whom, in particular, these remarks apply. Small coils are comparatively simple to make, such as those capable of giving a ½ in. spark for the ignition work of internal-combustion engines, or 1-in. as suitable for working in conjunction with ozonizers or illuminating tubes for spectrum analysis. Coils capable of giving sparks between 5 and 12 in. in length are in demand for work in radiography and X-rays, while those yielding sufficient potential difference between their secondary terminals to spark across an intervening air-gap still greater than this last, are suitable for theurapeutic work with high-frequency apparatus, and signalling without wires over long distances.

With regard to the smallest coils, these may well be wound in sections containing continuous layers of wire; but with the larger type of coil it is necessary to subdivide these sections. Taking the former type into consideration first, those up to the ½ in. size may be wound in two sections—*i. e.*, the secondary is divided into two equal portions by a central intervening disc of insulating substance; 1 in. coils, again, should be wound in four sections, and 2 and 3 in. in six. Above this size the method of winding must be different and will be discussed hereafter.

The secondary wire utilized for the purpose should in all cases be single silk covered; cotton, besides possessing comparatively poor insulating properties, requires much more space than silk. It may here be said, however, that a double covering of silk is superfluous, no benefit being derived from its use. Preparatory to commencement, let the bobbins of wire be well warmed to effectually cause the evaporation of any moisture contained in the insulation. They should then, if possible, be kept in a warm, dry place until the moment when required for use.

The paper utilized for this insulation of the respective layers of the secondary should be thin and thoroughly dry. It should not, however, be soaked in wax previous to use; it is far preferable to cover the layers with unwaxed paper to commence with, and so soak the whole winding in wax for 24 hours after completion. The reason of this is that it is difficult to closely cover a layer with paper that has been previously soaked in wax, and, moreover, when this is done, the paper occupies about three times more space than in the unwaxed state. The wire may, however be fed through a small trough of wax, with the result that the insulation will take up a sufficiency of this latter to saturate the paper when, after completion, the whole secondary is heated in a paraffine bath.

The layers of wire should never be wound so close to the edge of a section that there is any risk of one turn slipping below the level of its neighboring turns, for in the event of this occurring the high potential difference which would ensue between the adjacent layers would inevitably result in internal sparking and consequent failure. It is best to discontinue the winding of all layers at a distance of about 3-32 in. from the extremities. This will obviate any risk of such occurrence. The secondary must not, of course, be wound directly on to the ebonite tube, as this latter would not stand the heat if soaked in wax. The best mode of procedure under the circumstances is to make a thin tube of shellacked paper to exactly fit over the ebonite tube, and by means of paraffined discs of cardboard, to divide it into the requisite number of sections. This tube is then mounted on the winder and

is ready to receive the wire; then, after completion, the whole secondary is ready to be slipped bodily over the ebonite tube containing the primary and core. With reference to the direction of winding of the respective sections, each section should be wound so that the current will be in the same direction through all sections.

Before giving definite particulars as to the specific dimensions of the various parts of small coils, let me make one more remark applicable in general to these —namely, as to the winding of the primary. Where possible this operation should be performed with the aid of a lathe, or other suitable winding appliance, in order that it may be done as evenly as possible; and to effect economy as regards space, let both layers be wound with right-handed helices, as in the case of the primary of larger coils, in order that the successive turns of the second layer may occupy the grooves formed by those of the first. These points as to the primary winding are important, in order that the latter may be a good fit within the insulating tube without unnecessary waste of space.

I now append a table showing the dimensions of the most important parts of coils up to those capable of giving a 3 in. spark. In the case of the condenser the reader will understand that the figures imply the approximate total superficial area of foil. I leave it to the reader to determine upon the size and number of sheets that he will utilize to obtain the total area required, as this will vary to suit individual requirements.

	½ in. Spark.	1 in. Spark.	1½ in. Spark.	2 in. Spark.	3 in. Spark.
Length of core	6½ in.	7½ in.	8 in.	9 in.	11 in.
Diameter of core	⅝ in.	⅞ in.	1 in.	1 in.	1⅛ in.
Gauge of primary wire	20 S. W. G.	18 S. W. G.	16 S. W. G.	14 S. W. G.	14 S. W. G.
Internal diam. of ebonite tube	⅞ in.	1⅛ in. (full)	1⅜ in.	1½ in.	1⅝ in.
External diam. of ebonite tube	1⅛ in.	1⅜ in.	1 11-16 in.	1⅞ in.	2 in.
Approx diam. over secondary winding	2½ in.	3 in.	3½ in.	3¾ in.	4 in.
Distance between coil heads	4½ in.	5¾ in.	6½ in.	7½ in.	9 in.
No. of sections for secondary winding	2	4	4	6	6
Quantity of secondary wire	¾ lb.	1½ lb.	2 lb.	2¼ lb.	3¼ lb.
Condenser (total area of foil)	700 sq. in.	1.000 sq. in.	I,500sq. in.	1,800 sq. in.	2,300 sq. in.

We must now direct our attention to the larger type of coil—viz., those ranging in size between 4 and 12 in. Before considering the definite dimensions of various large coils, there are certain points dealing with the general design which I venture to suggest, among which some that I am not aware of being given elsewhere may prove of value to intending makers.

Firstly, I need scarcely say that it is essential that the secondary of any coil capable of giving upwards of a 4 in. spark should be wound in insulated sections of never more than ⅛ in. thickness, and that the method of winding in double, yet insulated sections, according to Hare, is not to be beaten, both in point of efficiency and convenience. Perhaps a simple disc, composed of two superimposed thicknesses of paraffined blotting-paper, suffices to separate the sections in the case of coils ranging in size between 4 and 8 in.

Beyond this, let Hare's method be adopted. With 4, 5 and 6 in. coils, I do not consider that the annulus of cotton wound into the section-former preparatory to feeding in the wire is necessary. It is better in this case, to allow the diameter of the central aperture of the section to slightly exceed that of the main insulating tube, so as to admit of a small interstitial space wherein wax may be poured when mounting each section on the tube after winding. In the case of 3 to 12 in. coils, the potential difference between the two extreme ends becomes so great that it is necessary to gradually increase the thickness of the insulating medium separating the primary winding from the secondary at the extremities of the coil are approached. This is effected by winding into the section-former, preparatory to feeding in the wire, thoroughly dry paraffined cotton until an annulus of the desired depth been formed. In the case of 8 in. coils the depth of this may be 0 at the center, gradually increasing to ⅝ in. at either extremity, while with 12 in. coils, ¼ in. at the center, tapering to ½ in. at the extremities.

When mounting the sections of the secondary the insulating properties of the coil may be materially increased by interposing at about every sixth section, a disc of thin sheet ebonite of a diameter slightly exceeding that of its adjacent section and having a central aperture of just sufficient size to permit of its being slipped over the main insulating tube. The thickness may well be 1-16 in., so that in a coil having forty-eight double sections, this would only result in an increase in the lateral measurements of half an inch.

In the secondary of a large coil it is advantageous that the contour of the winding, when finished, should conform with the direction of the magnetic lines of force of the core. The sections may therefore taper from a smaller diameter at the extremities to one somewhat larger at the center.

Before leaving the subject of the secondary let me add one more suggestion dealing with the winding of the sections, and that is, instead of merely feeding the wire through a small trough of wax, let the whole reel be immersed, whilst winding, in a paraffine bath. Then the wire will be heated throughout, and the wax which is absorbed by the insulation thus prevented from solidifying on its way to the section-former—an important point, as the mechanical stability of the sections is dependent upon this.

The iron core, though in every way the very heart or

essential part of a coil does not, in my opinion, receive sufficient attention by those who essay to construct their own coils. It is comparatively simple to make the cores of small coils such as those figured above. But the core of a large coil is a more formidable thing. The amateur, or even anyone who is not in possession of a special machine for cutting and straightening the individual wires, will find it impossible to satisfactorily make a large core. Even though he may take the greatest care in endeavoring to straighten each wire separately, he will find that, at most, he can only get his core to weigh two-thirds that of the purchased article, size for size. The reason is that all the wires of those that are machine-cut lie side by side, and parallel, throughout their entire length, with the obvious result that no space is wasted and the core consequently contains the maximum quantity of metal. The reader will find this factor figured in the table given, and if he is successful in his attempt at construction, then by all means let him profit by it; otherwise I strongly urge the purchase of a machine-cut core. In either event it will be necessary to anneal the core, which during the operation should be enclosed in a metal tube.

As regards the primary winding, I do not consider that on the whole any advantage is to be derived from the use of more than two layers of wire. Let each layer, however, be wound, as previously mentioned, in right-handed helices,—that is, the second lying in the grooves of the first. A double covering of cotton to this wire will afford sufficient insulation, provided the whole core, with the primary winding when complete, be first of all heated in an oven and thence transferred direct to a paraffine bath constructed for the purpose, and left therein for about 24 hours, or in other words, until air bubbles cease to be emitted. In all cases where a coil is designed for experimental work, it is advantageous to arrange, as suggested by Hare, that the layers of the primary may be connected either in series or parallel as desired.

The condenser, for convenience, should be built in four separate sections connected to a four-way plug key in such a manner that the capacity may be varied at will. The whole should be clamped between two good pieces of ½ in. mahogany, or some other hard wood.

Small coils are always of one shape—namely the simple "bobbin" form on an enlarged scale. But in the case of large coils, the shape of the body of the coil proper, and also the mode of fixing it to the base differ. It is desirable in all cases that the secondary terminals which are mounted on the top of the coil heads should be as far as possible from any metal or other conductor, and especially from any part of the core or primary circuit. With a view to effecting this, over the extremities of the main insulating tube fit short auxiliary lengths of a larger piece of tubing. Each of these is threaded with a male screw thread for a distance of ½ in. at one extremity and ⅜ in. at the other. The former fits a corresponding female thread in the center of the ½ in. ebonite cheek, while the latter screws into the main support at each end. A distance of 2 in. is thus left between the two opposed faces respectively of the coil-heads and supports. It is absolutely essential that these coil-heads be of ebonite; but the supports, which are best cut square, with the tops ornametally rounded off, need not necessarily be of that material, well seasoned mahogany or teak, stained and polished black, affording a good substitute. It may here be mentioned incidentally that an infusion of logwood only must be used for the purpose of staining, as lampblack, as generally employed, is a partial conductor.

Now, the mode of fixing the coil to the base, and of making the connection to the primary circuit, may be such as to enable the coil to be bodily removed from the base when desired with little or no trouble, and to be replaced with corresponding ease. This is extremely useful where the coil may be required for transport, and in numerous other instances. It consists in allowing for a protrusion of about 1 in. in length and ½ in. in thickness at each of the lower corners of the main supports when cutting these latter, so as to form, as it were, small projecting "feet." Then instead of permanently screwing the supports to the base from beneath, four medium sized bolts are fixed upright through the nut in such position that when the supports of the coil rest on the base the bolts may protrude upward through holes drilled through the four feet. A small mill-headed brass nut is then provided for and screwed on to each bolt, thus firmly securing the coil to the base, but in such a manner that it may be instantly taken off whenever it is desired.

The method of making the connections through from the primary coil to the base is best done by fixing to each of the two supports two telephone pattern terminals, one on either side of the central aperture. thus making in all, four, to which the four ends of the primary winding respectively are connected. Then directly beneath and reaching to each terminal, an upright length of ½ in. brass rod is fixed through the base and connected with the wires below, so that when the coil is placed on the base these shall pass through the holes in the terminals, as the bolts through the holes in the projecting feet of the supports.

In the tables of the sizes of large coils which I now append, it must be understood that those of the 4, 6, 8 to 10 in. size are of one of the designs referred to. Above this size, however, the design suggested by Hare is to be preferred as affording better mechanical stability in the case of these very large coils, which are extremely heavy. This fact should be borne in mind when reference is made to the table.

Before concluding, let me advise readers against the use of the Wehnelt or other electrolytic interrupter in conjunction with coils, unless the latter be specially designed for this purpose, which means additional insulation throughout all parts of the secondary wind-

	4 in. Spark.	6 in. Spark	8-10 in. Spark.	12-14 in Spark.
Length of core	10 in.	13 in.	17 in.	18 in.
Diameter of core	1⅛ in.	1¼ in.	1½ in.	1 11-16 in.
Weight of core	2½ lb.	4 lb.	7½ lb.	8 lb.
Gauge of primary wire	14 S. W. G.	14 S. W. G.	14 S. W. G.	14 S. W. G.
Internal diameter of ebonite tube	1¾ in.	1¾ in.	2 in.	2 3-16 in.
External diameter of ebonite tube	2⅛ in.	2¼ in.	2½ in.	2 11-16 in.
Average diameter of secondary sections	3½ in.	4 in.	5½ to 6 in.	6 to 7 in.
Number of double sections	30	38	48	48
Distance between coil-heads	7 in.	9 in.	12 in.	14 in.
Quantity of secondary wire	4½ lb.	6½ lb.	9 lb.	15 lb.
Condenser (total area of foil)	3,000 sq. in.	4,000 sq. in.	8,000 sq. in.	10,000 sq. in.

ing. The use of this type of break with an ordinary coil will certainly impair efficiency, and finally cause the breakdown of the whole coil, either as the result of internal sparking or, what is worse, fusion of the secondary wire.

Moreover, in radiography, no ordinary tube will stand the excessive discharge of the coils actuated by these breaks, the anti-kathode invariably being fused and the tube consequently destroyed. It is necessary in these cases to employ a specially constructed tube, having a hollow water-cooled anti-kathode, that the excessive heat which is generated may be conducted away as rapidly as possible. But even if this is the the case, another trouble will ensue—namely, rapid and frequent alterations in the degrees of vacuum of the tube. The reader is therefore strongly urged to adhere only to the platinum and mercury breaks. Among the former of these, that type known as the "Vril," is by far the best and most efficient. With its use, by reason of the principle of mounting the platinum contact-piece on a separate spring, the maximum degree of magnetic saturation of the iron core is obtained at every contact, which is impossible in the case of the simple type of platinum break.

Care should be taken that when working, the tension screw is not turned back too far, as when this is the case the platinum surfaces remain in contact for a longer period then it necessary to effect the above-mentioned purpose, and consequently a needless waste of current ensues. If accumulators be utilized as the source of energy, this is liable to impair their efficiency through causing an over-excessive rate of discharge. When the current is switched on let the tension screw be gradually turned only until the maximum efficiency of the coil is reached, and no further.

To obtain without risk the best results from a large coil, the rotary mercury, or any other well-known type of mercury interrupter is excellent. A comparatively simple yet efficient break of the former type is not difficult to construct. It consists of a circular disc of thin sheet brass, about 2 in. in diameter, having four equidistant projections protruding beyond the periphery, which is attached to the extremity of the shaft of a small drum-armature motor. A small receptacle containing mercury is so placed under this metal disc that when this latter is rotating, the four protruding blades may alternately make and break contact with the mercury. The edges of the blades should be circular, so that by raising or lowering the level of the mercury, the period of contact can be correspondingly regulated. The frequency of the interruptions may be regulated by the speed of rotation of the motor, which is best effected by including a rheostat in the circuit of the motor and its source of supply—preferably a four or six volt accumulator.

The interrupter is included in series with the main primary circuit of the coil, the current passing through the mercury and shaft of the motor, by way of the revolving metal disc. It is sometimes advised that the contacts of the platinum break should be screwed together, and the mercury interrupter included externally in the circuit. This, however, is inadvisable, as by so doing the function of the condenser is destroyed. The correct way is to connect, as usual, the source of current with the main terminals of the coil, to separate the contacts of the platinum break, and then to connect the mercury interrupter to the respective pillars of the latter, for which purpose terminals should be provided for the base of the coil. The condenser is then not short circuited, with the result that the full effect is produced with the coil.

Here, as with platinum breaks, however, let care be taken not to render the period of contact longer than is absolutely necessary to effect the full degree of magnetization of the iron core, for the reason explained above. It should be borne in mind that the inductive effect between the primary and secondary windings occurs only at the moment of the alternate make and break of the current, and no advantage is to be derived from a continuous flow of current. To obviate risk, therefore, of this occurrence, especially when accumulators constitute the source of energy, the period of contact when the current is switched on, should be small, and then gradually increased until the desired effect is obtained.—"English Mechanic."

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AMATEUR WORK.

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New advertisments, or changes, intended for a particular ssue, must be received at this office on or before the 10th. of the previous month.

Entered at the Post Office, Boston, as second class mail matter, Jan. 14, 1902.

OCTOBER, 1905.

The present number completes the fourth year of the publication of this magazine. We take this occasion to express our sincere appreciation of the cordial support given us by our readers, and of our intention to deserve a continuance of their patronage by furnishing a magazine which will contain so much of value to its readers that they cannot dispense with it.

Merit is the great criterion of success in these days in all lines of industry, and by that standard we shall shape our work. Our readers can render valuable assistance if they will, by suggesting topics they would like to have written up, and suggestions of this kind will be thankfully received and acted upon as far as practical.

Also, in another line valuable help can be given. If readers will but call the attention of friends to the magazine, the number of readers can be largely increased, which increased patronage will, in turn, enable us to further enlarge the size and scope of the magazine to the advantage of all.

In this number will be found a brief description and drawings of a model steam engine. The November number will contain one of a horizontal engine of equally diminutive size. Our purpose in presenting these descriptions is to learn if our readers are interested in them, or similar models. If a sufficient number of requests should be received, patterns and castings will be prepared and offered as premiums. Suggestions as to variations from these designs will also be welcome. In the event of a sufficient demand, descriptions of boilers, suitable for furnishing steam will also be given. If you are interested, therefore, write and tell us so, as this is the only way we can learn of it.

Model making as a means of studying engineering subjects, is not appreciated in this country to near the extent which it deserves. A model steam engine and boiler, if well made and complete in its parts, taken in connection with a good text-book, afford all that is required to become sufficiently familiar with steam engine running to enable one to successfully pass the examination for a second-class engineer's license. Such a license places the holder in the position of being able to readily obtain work at fair wages; better by far than is received by the dry-goods clerk, whose clothes may be cleaner and necktie larger than the engineer, but who has little or no future advancement to look forward to. In a similar way, a telegraph outfit will enable the owner to learn telegraphy, and good openings for temperate men are always available. It pays to have an aim in life, and by beginning early and working steadily, the goal is reached in time. Get a hobby, then, and ride it.

The number of inquiries regarding the offering of premiums not included in our regular list make it necessary to again state that any article desired by a subscriber will be offered as a premium upon request, at terms as favorable as possible. Many have obtained numerous electrical or mechanical tools or instruments, and others could, if but willing to make a little effort. Fill up your tool chest in this way; it is easily done.

ELECTRIC BATTERIES; THEIR CONSTRUCTION AND USES

FREDERICK A. DRAPER.

II. Polarization—Single and Double Fluid Cells.

As noted in the previous chapter, during the action of a cell, the hydrogen bubbles which are liberated collect on the surface of the negative plate or cathode, and unless removed by chemical or mechanical means, obstruct the chemical combination producing the difference in potential between the electrodes of the cell, and the current flowing through the external circuit is decreased. This is known as "Polarization," and its removal is termed "Depolarization."

Several methods have been used to remove the hydrogen bubbles, such as agitation of the fluid, which causes the bubbles to rise to the surface and pass off into the air; accomplishing the same result by heating fluid or by forcing air through it. These methods are all of external operation, the power usually being of clockwork except in the case of heating. They have no advantages over the method in general use, the chemical one, in which the negative element is surrounded by a solid or liquid substance possessing great affinity for the free hydrogen. The free hydrogen readily unites with the depolarizer, providing the current developed by the battery is not great enough to evolve hydrogen in excess of the capacity of the depolarizer to unite with it. It is evident, therefore, that the design of a cell, and the area and quantity of its elements must be proportioned to the current to be drawn from it.

The depolarizing chemical is one rich in oxygen, which unites with the free hydrogen to form water, thus gradually diluting the electrolyte until eventually the cell is so weak as to require a new supply of electrolyte for continued use. Where a depolarizing chemical is used, it is also necessary to select elements which will have little or no affinity for the depolarizing chemical, else when no current is passing through the external circuit, the action within the cell, known as "local action," will continue, and the elements used up without having performed useful work in the external circuit. It is necessary then, in order to have a practical cell, that the elements composing it should be without action, except when the electrolyte is decomposed by the passage of the current.

It is also desirable that the difference in potential between the electrodes be as great as possible, that the output of the cell be large. Here again the depolarizer may be of value, as, if possessing affinity for one element only, the resulting combination therewith develops a potential difference which is additional to that of the decomposition of the electrolyte, and so increase the E. M. F. in the external circuit. On the other hand, if more than one element in a cell has an affinity for the depolarizer, combination takes place, independent of the decomposition of the electrolyte, and the E. M. F. in the external circuit is reduced. This explains why two cells in which the same metals are used, but with different electrolyte and depolarizer, do not give off the same E. M. F. in the external circuit, or continue in efficiency for the same length of time. The reason for the wide variety of combinations to form the numerous cells on the market is also evident, each type having uses for which it is best adapted, and to explain which is the purpose of these articles.

The metal most nearly answering to the requirements already noted is zinc, which, in proportion to the energy which may be developed by chemical combination, is also the cheapest metal which can be used, and hence we find it in almost universal use in those forms of cells in common use. Unless refined for electrical use, the impurities usually to be found in commercial zinc cause local action which diminishes the efficiency of the cell and which is avoided by amalgamating the surface with mercury.

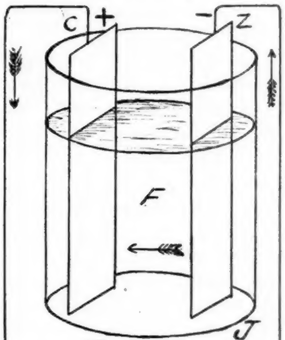


FIG. 1.

A convenient way of amalgamating zinc is to first thoroughly clean the surface of the metal of grease with common washing soda and warm water and then rinsing it in running water, with a pledget of cotton wool which has been dipped in dilute sulphuric acid (water 10 parts, acid 1 part, by bulk), rub the surface of the metal, and while rubbing, pour on the mercury, drop by drop, spreading it over as great a surface as possible with the pledget. Another way is to mix the mercury with the acid solution and apply with the pledget. In either case care must be taken to avoid the use of too much mercury, as it causes the zinc to become brittle and easily broken. Amalgamating the

zinc is of value only when an acid electrolyte is used; with a saline solution it has little or no protective effect.

In some forms of cells the formation of free hydrogen is not great enough to seriously affect the normal action of the cell, even if no depolarization is used, or if one be used, it is in solution with the exciting fluid. This leads us to divide the various forms of batteries into general classes, viz., "single fluid" and "double fluid" cells. The single fluid cell is illustrated in Fig. 1 in which *J* is the containing jar, *F* the exciting fluid, which may or may not have in admixture with it a liquid having affinity for the liberated hydrogen; in this fluid are the plates Z and *C*. The plate marked Z is a metal readily acted upon chemically by the exciting fluid and *C* a metal which is a good conductor of electricity, but upon which the exciting fluid has little or no action. The function of plate *C*, is to collect and convey to the external circuit the electrical force resulting from the chemical action between the exciting fluid and the plate Z.

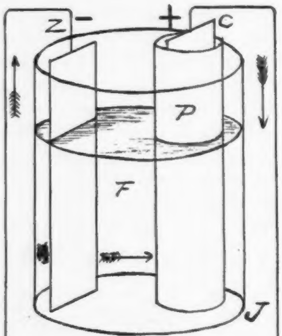


FIG. 2.

As the chemical action starts at the plate Z and the E. M. F. develops at this point and flows in the cell from this element to the element *C*, it is usual to term the element Z "positive," having as it does the higher level of energy, and the element *C*, which receives and transmits to the outside circuit, is termed the "negative" element. As regards the outside circuit, however, these terms are reversed when applied to the points of junction with the outside circuit, and known as the "poles" of a battery. The positive pole is that from which the current flows, and the negative pole that by which it returns to the cell. Keeping in mind the fact that the point of origin is positive, whether applied to element or pole, will serve to keep clear this apparently contradictory application of terms.

In the double fluid cell, as illustrated in Fig. 2, we note the addition of the porous pot *P*, in which is placed the carbon plate, and also some fluid or substance having great affinity for the free hydrogen which would ordinarily collect upon the surface of the negative element *C*. Either positive or negative element may be placed in the porous pot, providing always that the depolarizer shall accompany the negative element.

It is also important that the pot be very porous, for while it serves to separate the exciting fluid and depolarizer, it must offer the least possible obstruction to the action of the cell causing the flow of the current.

MATCH MAKING.

In the latest match making machine, the wood from which the match splints are made is pine plank two inches thick which, after thorough drying is re-sawed into lengths one and seven-eighths to two and one-half inches, representing the length of the matches to be made. The knots and cross-grained parts are cut out of the blocks and these blocks are put into the automatic feeder of a machine, the paraffine and composition for the head of the match having been properly prepared and placed in their respective receptacles, where they can be replenished without stopping the machine. The knives or dies that cut the match splint from the blocks are so placed in head block of the machine that when the splints are cut they are separated by a quarter of an inch and placed or set in castiron plates made into an endless chain by link attachments. At each revolution of the machine 44 matches are cut and set, the machine making 175 to 250 revolutions a minute. From the cutting end of the machine the endless chain moves along over a drying or heating block prepared for this purpose where the match splint is heated to a degree nearly equal to that required to melt paraffine so that the paraffine may not chill on the stick when the splint passes through it, but that the end may be thoroughly saturated. The chain moves on to the composition rollers where the match receives its head, and then comes into contact with blasts of cool dry air for an hour and a half, when it returns to the place of beginning, just before reaching which the matches are punched out of the chain by an automatic device into small paper or strawboard boxes varying in size, containing 65 to 500 matches, the boxes having been fed into the machine automatically. Two million or more paper or strawboard boxes are consumed each day in the packing of matches in this country. One million and a half pounds of chlorate of potash are consumed annually in the manufacture of matches.

The most remarkable fall of meteorites known to history was that which occcrred at L'Aigie in France in 1803. Between 2000 and 3000 meteoric stones fell over an area of nine miles long by three wide, some of which weighed 50 pounds or more.

A CHEAP NINE-INCH REFLECTOR.

M. A. AINSLEY.

V. Apparatus for Testing Lenses.

Presuming that the reader has mastered Chapter IV, giving the theory of the pinhole test at the center of curvature, I will briefly describe my apparatus:—It simply consists of a wooden baseboard (metal would be even better) to support the lamp, taken from a cheap bicycle, which gives a flame ½ in. wide. Immediately in front of the flame is a vertical wooden board (4 in. x 2½ in.), which has a ½ in. hole level with the brightest part of flame. This supports, on the flame side, a brass plate with a hole 1.160 in. in diameter. This I got drilled by a watchmaker with a drill .15 millimetre in diameter. The plate with a hole in it can be easily removed or placed in position, and a screen of tin round the lamp shields the eye from its light.

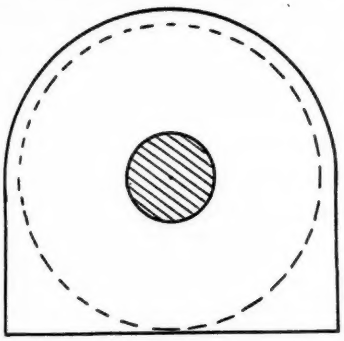


FIG. 1.

Immediately to the left of this lamp, and so that its center line is not more than 2½ in. from the pinhole, and on the same level, is a brass tube supported on two wooden Vs and, of course, parallel to the line joining flame, pinhole and mirror. A line is cut round the tube, accurately at right angles to its axis, as an index, and the position is measured by an ivory millimetre scale attached to the Vs; 1 mm. = 4-100 for all practical purposes, and it is easy to estimate to ¼ mm., or 1-100 in. The mirror is supported against a stout board and rests on a shelf on the board. It is placed at a somewhat lower level than the apparatus. If the tube used is, as in my case, the "draw-tube" into which the e. p.'s screw, an efficient "occulting screen" be made by removing the lenses of a low-power eyepiece and using the diaphragm or stop, which limits the field of view.

The testing apparatus and speculum should be supported on firm supports, tripods if possible, on a stone floor; but testing may be carried on, as I found, even in an upper room, if it is done late at night so that no one is moving. The distance between pinhole and speculum is approximately twice the focal length; not exactly, because the image of the pinhole is a few inches further from the mirror than the pinhole itself. This makes no practical difference in testing, though if the pinhole were much nearer the mirror, the formula for aberration would have to be altered.

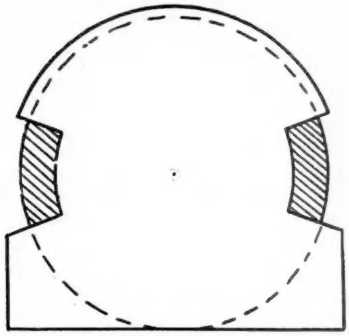


FIG. 2.

The screens used for hiding the parts of the mirror are two in number Figs. 1 and 2 and, these may with advantage be combined into one, Fig. 3. The central slide may be 2 to 2½ in. in diameter, and the segment left in the outer zone, Fig. 2, may be 1 in. broad

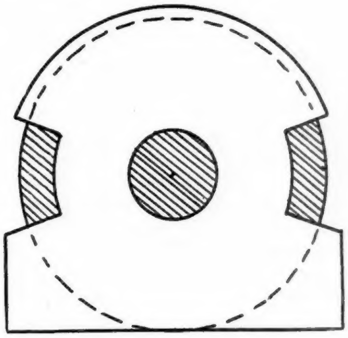
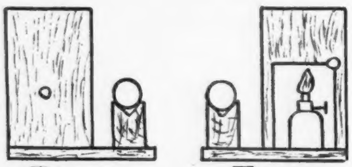


FIG. 3.

and 3 in. long. I found the combined screen easiest to work with. Provide also a white paper cap to fit over the front end of the tube; this is useful in adjusting the position of the apparatus.

Light the lamp and see that the brightest part of the flame is opposite to the pinhole. Remove the pinhole and let the light shine on the mirror through the hole in the vertical board; place the tin screen round the lamp to darken the room; the room, of course must be otherwise dark, or nearly so. Then place the apparatus at a distance from the mirror, approximately equal to twice the focal length of the mirror, *i. e.*, the radius of the curvature. Move the mirror about until the image of the flame, seen through the ⅛ in. hole, is received on the paper cap at the end of tube; remove the paper cap and view the mirror through the tube, taking care that the tube is accurately pointed to the center of the mirror. Move the apparatus to or from the mirror until the image of the hole is at the eye end of the tube; insert the plate with the pinhole in the testing apparatus and focus the image with eyepiece or lens of some sort.



We may now take a preliminary examination of the image. As in Chapter IV, the appearance of the image inside and outside the focus will give an idea of the class to which the curve belongs, remembering that Class A (oblate spheriod) gives bright center outside and dark inside focus; Class B (sphere) gives the same uniform appearance inside and outside focus; Class C (ellipse, parabola, hyperbola) give bright center inside and dark center outside the focus.

Next, remove the lens, or lenses, and bring the image, by moving the apparatus to the edge of the screen used for testing, *i. e.*, if the diaphragm of the eyepiece is being used, bring the image to the right-hand side, so that further movement of the apparatus to the left will cut off the light. The image must be kept level with the center of the tube, and the whole apparatus packed with paper until it is so. A slight pressure with the hand on the left-hand side of the baseboard will just cut off the light, and the tube is pushed or pulled until the illumination of the mirror disappears as evenly as possible, the eye being meanwhile placed as close as possible to the image, so that the mirror is seen as it were flooded with light.

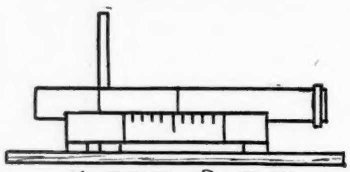
It is important that the mirror rest against a backing of uniform color, a piece of black velvet or cloth being most suitable; also it must be left to get thoroughly cool after polishing, or the image will be irregular and the testing unsatisfactory.

The mirror must be handled as little as possible. A finger placed on the surface for a half a minute produces a slight elevation which is easily visible in testing; in fact, once the mirror is in position, it ought not to be touched at all until testing is completed.

The adjustment of the mirror to reflect the imag through the tube is a long job at first. A large sheet of white paper held behind the testing apparatus to receive the image of the hole is a great help.

I assume now that the polish has became perfect all over the glass. This is a question of time, but if the polisher is properly made, should not take more than four hours, and that the curve is either A or B—*i. e.*, still on the safe side of the sphere. We may now bring the mirror screen into action. First of all, place the testing screen (by which, to save confusion, I shall denote the diaphragm in the eyepiece mount placed close to the eye, as described in my last) as near as possible to the image of the pinhole, and observe whether the shadows seen on occulting the image are regular. If, owing to the faulty construction of the polisher, any rings or irregularities appear, it may be necessary to return to the latter stages of the fine grinding; but such irregularities are easily perceptible in the earlier stages of polishing, and can be avoided by care in making the polisher and in adjusting the position of the central square, as before described. I have not been troubled with " rings " in my own work, and I believe they can always be completely avoided with care.

Now put in front of the screen No. 1, or if one screen only is to be used, No. 3, and gently and slowly alter the position of the tube in its Vs until the testing screen, when brought across, darkens the central part of the mirror uniformly. By keeping up an intermittent pressure with the hand on the left side of the baseboard of the testing apparatus, the mirror may be made to darken and brighten alternately, and the tube is moved very gently with the right hand until the appearance of a shadow advancing across the mirror, or rather the central portion left by the mirror screen, is lost, and the darkening is even all over. Read the



scale, estimating to ¼ mm. or 1-100 in. This should be repeated many times, the testing-screen being placed, to start with, alternately outside and inside the focus. The mean of all the reading is then taken.

Now concentrate attention on the outer zone. As will be seen in Figs. 2 and 3, only two segments of this zone are visible, one on each side, and to get the best results, the testing screen, at the point where it occults the image, must be vertical—*i. e.*, the image must be level with the center of the aperture whose edge is being used for testing. A vertical bar across the end as the tube does as well as the eyepiece diaphragm; but I found the latter more convenient. The scale is read again when the two segments are found to darken simultaneously; and, from the greater con-

vergence of the rays from the two sides of the mirror, it is rather easier to observe the exact focus than when the central $2\frac{1}{2}$ in. of the mirror is observed; in any case, however, the mean of several readings should be taken.

The difference between the final means gives the actual difference between the focus of the mirror (for rays diverging from the center of curvature, of course) for the center edge of the mirror. If the focal length for the center is large,—*i. e.*, if the first reading was greater—the mirror belongs to class A; if the focus is the same for both, the mirror is spherical, class B; and if the reading for the outer zone is greater than for the center, class C.

It is desirable, after reading off the scale for the outer zone, to make another set of observations of the the center, to make certain that the testing apparatus has not shifted. It should be heavy enough to remain still. The use of the combined mirror screen, 3, I found a great advantage, as I could remain perfectly still during the whole time, and thus risk of shaking mirror or testing apparatus was avoided.

We now know exactly what sort of curve we have got, and we now want a formula which will give the exact difference between the readings ("aberration" is the name commonly used) for the parabola, C^2.

The formula giving the necessary aberration for the parabola is $\frac{D^2}{8F}$, where D is the mean diameter of the zone, and F the focal length. It may also be written $\frac{r^2}{R}$, where r = means radius of zone, and R = radius of curvature of the mirror, which is twice the focal length (= 2 F.)

N. B.—The distance from pinhole to screen is equal to the radius of curvature. Either formula gives the same result, but I prefer the former. It will be noticed that the aberration is twice the depth of the center of the mirror below the line joining opposite middle points of the zone—e. g., if the zone used on a 9 in. mirror of 6 ft. focus is 1 in. wide, its mean diameter is 8 in., and its depth, measured from the plane of the 8 in. circle, is $\frac{(8)^2}{16 \times 72}$ = 1-18 in., while the aberration to be aimed at in the figuring would be $\frac{(8^2)}{8 \times 72}$ = 1-9 in. = .11 in., or $3\frac{3}{4}$ millimeters. It will be seen that this is but a small quantity; but it must be measured accurately, as on it depends the whole performance of the mirror.

It must be noticed, however, that this is the theoretical value. As I was told by an expert, "Here mathematics must take a back seat," and he further told me that the practical value is somewhat less. I did not find it so; but, in any case, it is safest to carry on the figuring process, (to be described later) until the aberration is about $\frac{3}{4}$ of this, or, in the case under consideration, about .08 in. The final testing must, after all, be done in a telescope, on a star, and with a good eyepiece. I would again quote Sir J. Herschel: "That is a good form which gives a good image." If the aberration becomes too great at any time, the curve becomes C^3 (the hyperbola, and it is very difficult to get back. A, B and C all mean safety, but C^3 means danger. When my mirrors appeared to give perfect results in the telescope, I found, in testing with pinhole and screen that they gave the theoretical aberration. "English Mechanic."

GALVANIZING PROCESS.

Consul-General Guenther, of Frankfort, writes that German papers report that Mr. Cowper Coles, an Englishman, has invented a new process of galvanization, and has recently demonstrated the same with samples of iron, copper, aluminum, and other metals. The objects to be galvanized are simply heated to 260° in a bath of zinc vapor, the duration of which depends upon the desired thickness of the coating, but which is always short. After heating the objects are thoroughly coated with a layer of zinc, which on the surface has formed an alloy with the other metal by penetrating into it to a considerable depth. A copper rod can in this way be almost entirely transformed into brass, while the temperature employed remains far below the melting point of both metals. A great advantage of the process lies in the evenness of the coating, which is so perfect that such zinc-galvanized screws and bolts afterward fit perfectly into the nuts, while with other methods they have to be polished. It is also very convenient that the objects to be galvanized have not first to be cleaned.

The retorts in which the heating takes place are of iron, and are heated from the outside. Another peculiar advantage is that the zinc does not adhere to the walls of the retort, but that these, after months of use, are entirely clean. The explanation for this is that the walls of the retort are heated most, so that no zinc vapor condenses on them. Experiments to use the the process with metals other than zinc have been so far made with copper and antimony, and have been partly successful, but not to a degree to make them of practical use.

One of the recent patents in the gas engine line is a starting device using superheated steam as the motive power. The starter contains a series of coils of pipe of small size which aggregate about 60 feet of heating surface. A pint of water injected into these coils by a small force pump, within 10 seconds is converted into steam at a pressure of from 100 to 1000 pounds, as desired. There is no reservoir, and the steam is released automatically into the gas engine cylinder before it reaches the tested capacity of the starter.

THE PRACTICAL UTILITY OF MANUAL AND TECHNICAL TRAINING.

Abstracts from an Address delivered by Wm. Barclay Parsons before the National Educational Association.

Not being engaged in education, I approach the topic of this evening's discussion, namely, "The Practical Utility of Manual and Technical Training." not as an educator, but as one engaged in practical work, where both manual and technical training play their parts, and I shall speak, therefore from the point of view of results achieved and of ends to be attained.

The statement is almost axiomatic that, any particular educational work, precisely the same as work of other kinds, must pass the supreme test of practical efficiency if it is to assume a permanent place.

Unless special educational training can show some actual value in making men or women better able to meet the ordinary demands of life, no matter how desirable it may seem, it has no reason to exist and must in the end give way to other work or to other subjects that will employ the student's time more profitably. It is, therefore, by actual results that we are to judge of the value of any teaching, and by this same standard, of the practical value of manual and technical training. The question is, whether students are sufficiently improved thereby to compensate them for the time spent.

Subjects that are taught in our schools and colleges may have one or both of two values: they may be useful in developing the reasoning faculties, thus fitting the student to deal later with the actual problems of real work in the same way as gymnastics develop the muscles of the body, and are thus useful, though one may not become a gymnast; or the subjects may have a direct value, *per se*, as do all subjects that will later have bearing on actual daily vocations. It is not for me, in a gathering of educators to discuss the relative importance of any subject of the former class. Others who will address you will cover the value of manual training from the standpoint of mental devolopment—if that phase of the question requires any consideration or argument—while I, within the narrow compass of this paper, will invite your attention to a considera tion of the subject solely from the standpoint of practical utility, and with regard to better fitting young men for the actual demands of work to come.

When manual training was first brought forward, it as with a view of its use as a means of mental development; it has, however, a much wider field, a more precise application, and an actual educational value of great practical utility. We are all conscious of the tremendous progress in mechanical development that has taken place within the last fifty years, more especially during the last twenty years, and that is still going on at an increasing ratio. It was not so very long ago that the great source of wealth was in agriculture, where work was performed by the most rudimentary unskilled labor, while even in mining and in the mechanical arts, implements were of the crudest form. On the strength of men's legs, arms and backs was the main reliance for power. Today it is hard to call to mind a single trade in which machinery of intricate form does not enter in some degree, and usually to a great extent, machines requiring on the part of the operative some knowledge of mechanics, some experience in manipulation, and some skill in manual dexterity.

The hand needle has given way to the sewing machine, the farmer's foot loom and spinning wheel, to exceedingly complicated machines of great capacity, engine driven; the telephone is used in place of the messenger; a machine and not a pen writes our letters, while our stables are repair shops for motor cars. Such are but few of the many examples in our every-day life that occur to one, where mechinery is displacing hand work, and where skilled labor is taking the place of the unskilled.

A measure of the number of persons dependent upon mechanical pursuits can be obtained from the reports of the United States Census Bureau. The report for the decide ending 1900 shows that there were then 29,000,000 persons engaged in various occupations. Of this number there were no less than 8,000,000, omitting entirely all those engaged in agriculture, employed in occupations where tool and machine knowledge formed the basis of work, while in nearly all of the others some such knowledge was desirable and in many cases essential. It is not an exaggeration to say that machine and tool work form a large part of the daily vocation of a majority of the working classes in this country; that there is not a single calling where the worker is not required to show some familiarity with tools and where some proficiency in mechanical dexterity will not lead to his advancement. In fact, it would seem that after the great foundation of all education, reading, writing and arithmetic, there is no one subject of so widespread practical benefit as that of teaching the art of using the hands. With the masses an education that develops the thinking power alone is of small value; it produces a development that is ineffective, that cannot be used. Give a man a rudimentary education, with an understanding of how to do things, and the educational foundation of productive capacity has been laid, which capacity governs the wage-earning power. The practical utility of manual training is the instruction of the rising genera-

tions in the use of tools, the education not only of the the mind but of the hand and eye, and in teaching a subject that will later be an actual portion of the life of the majority of students.

The limit to which manual training should be carried is to be considered from three points of view: the elementary work in the lower grades, the specialized work in the trade schools, and the higher in the technical colleges. As to its practical value in our technical colleges, we must differentiate between the technical college and the highest grade of trade school, especially in the matter of manual training. The one aims to turn out the professional engineer, educated not only in the technical sciences, but in the liberal arts as well, to whom time and money spent in procuring an education are quite a secondary consideration as compared with an education itself; the other aims to develop the highest grade of mechanic and general foreman.

Although there is a great difference in the scope of the educational work in the technical college and the most advanced of trade schools, yet there is the similarity that both deal with mechanical appliances, but with this distinction, that the men of the latter will in practice have to do with their own hands their own work, while those of the former will direct other hands to do it. It is not essential, therefore, that a technical college should carry manual training to the same point of development as the highest grade of trade school does. In the education of the engineer there should be enough manual training to make him understand how things are made, to sufficiently familiarize him with casting and forging, hand and machine tools, engines and their adjustment, the winding of dynamos and the connections of electrical devices, so as to give him the requisite knowledge of how to design, how the engine should be used and how construction results can be accomplished. In short, to make him conversant with principles rather than to develop manual dexterity.

This brings us to the question of the practical value of technical training itself and whether it is better that young men who are to follow a professional life in engineering should get their education in the office of an older practitioner, as has been the custom in England, and is still to a large extent the universal custom in teaching the allied subject of architecture, or to gain the same end by passing through a technical college, the practice in America and Germany. To quote the growth of technical colleges is not necessarily a rational argument, but it certainly goes to show popular appreciation. In 1870 there were less than half a dozen institutions in the United States where a good technical education could be had, and the number of students was small. Today there are no fewer than 43 such institutions, with over 23.000 students enrolled.

Before considering the practical value of technical education, let us define what is an engineer and what the vocation known as engineering. The word "engineer" is used here in its broadest sense, including all branches of professional work in applied science or construction. The word "engineer" is not, as is popularly supposed, derived from the word engine, a machine. There were engineers before steam was practically applied, or before the development of engines in the modern acceptation of the term began. Both the words "engineer" and "engine" come from the same derivation, the Latin "ingenium," whose prime meaning is "natural quality, character, genius," and it in turn is derived from "gegno"—to produce. The engineer is, therefore, a man of "natural quality"—one capable of producing.

The profession of engineering, in its broadest sense, was defined by Thomas Tredgold, when founding the Institution of Civil Engineers, as being "the art of directing the great sources of power in nature for the use and convenience of man." It is difficult to imagine a field of work of higher order, of wider scope, and for which a more complete technical training is essential.

The powers of nature, those great and mighty forces that surround us, that sustain and govern not merely our own small earth but the whole universe; powers that are without limit as to time and space, whose laws never vary, whose manifestations may undergo change but which never suffer loss, and which are the only things that we have cognizance of that are of perfect truth—these forces in all their might, from the great energy of the engine capable of lifting mighty weights, or the violence of an explosive rending mountains of rock, to the gentleness of the watch spring in your pocket, regulated to a variation of less than a second a day, are by the study of the engineer controlled and directed for the use and convenience of his fellow men.

How little did Smeaton foresee the development of civil work, to which he applied such a designative title! How little did Tredgold realize the far-reaching effects of a calling to which, it is true, he gave unlimited bounds! The responsibility of educated men who are to follow Smeaton, who are to realize the ideals of Tredgold, who are to understand, direct and make useful the powers of nature, rests upon such as you who make up this audience. It seems but necessary to repeat that definition of engineering which in simplicity of language, in directness of thought, in broadness of conception, has never been excelled, to at once answer the question whether such education is better given in special technical colleges or in the office of some one practitioner. What are these powers of nature? They are not only those that we see or feel every moment—light, heat, steam, gravity, but also those studied by the electrician, by the chemist, by the physicist, by the geologist, and by the other disciples of pure science; those intricate forces that, whether matter consists of many or few elements, give it such a manifold and diversified character.

When the total of human information of these several branches of science was comparatively limited,

when the engineer could depend largely upon precedent, when progress was made by short and careful steps, it was possible for a sufficient education to be acquired under the tutelage of a single man, leaving it to the inherent genius of the pupil to self-develop. With, however, the vast and constantly broadening field of modern scientific knowledgo, it is quite impossible for one man, or such a limited group of men as one office may contain, to impart to the young student the requisite instruction in all the properties of the forces and materials of nature that he should have as a general framework of his professional education.

Although engineering, like other learned professions, is divided into separate branches, nevertheless the modern engineer must know something of machine design, of electricity and its practical application, of hydraulics, transportation, structural constraction together with physics, geology and metallurgy. If such a structure be built on the solid foundation of a good education in the liberal arts, so much the better will it be, and obviously such a preparation can only be given in an institution with a corps of specialists. It seems a contradiction to say that as any profession becomes more specialized, at the same time it becomes broader, but as a matter of fact, the range of subjects to be studied does become wider. It is not necessary, in fact it is impossible, for any one to become expert in all branches; yet so interdependent are the several divisions, so interlocked are the various nature forces that some knowledge should be had of many subjects and much knowledge of few.

TECHNICAL EDUCATION IN GERMANY.

Though the average American is far ahead of the German or Frenchman in inventive talent, he is handicapped by lack of technical knowledge, reports Richard Guenther, Consul-General, Frankfort, Germany, February, 1905. The little town of Sonneburg, in Germany, for instance, has an industrial school which has been in existence for twenty years. This school gives instruction in drawing, painting, modelling, turning in wood and ivory, wood carving, geometry and arithmetic. The principal object is to train young people for the manufacture of toys and ceramic ware, which are the chief industries of the district. The school has 24 students, and the cost of tuition is but 50 marks ($12.90) per year. Additional technical schools, giving instruction in glass blowing, painting on porcelain drawing, modelling and carving, are located in Schlakau, Limbach, Lauscha, and Rauenstein, which are quite small places in the Sonneburg district. The town of Sonneburg has also a commercial school attended by 152 pupils, who are instructed in commercial knowledge, political economy, the English, French and Spanish languages, bookkeeping, stenography and typewriting, calligraphy, and arithmetic. The efficient training given by such schools makes Germany capable of successfully competing with countries possessing superior natural advantages, nnd accounts in part for the wondersul rise in Germany's export trade and merchant marine.

PURIFYING WATER WITH OZONE.

The Ozone Plant in West Philadelphia is in operation and tests of its work in water purification have been made by Messrs. Rivas, Jackson and Hale. Raw Schuylkill River water contains as high as 2,500,000 bacteria per cubic centimeter. After rough straining this number is reduced to 250,000 to 700,000, and after the ozone treatment to 5 to 55. These few are all harmless varieties, and the water is also deoderized and freed from color. The process, which is controlled in this country by the United Water Improvement Co., is substantially as follows: An electric current is taken from the city's wires to operate a motor generator, producing a current of 100 alternations, which is raised by transformers and condensers to a 10,000 voltage. By the operation of reactance coils and condensers, voltaic arcs are prevented and sparks are limited, and the current passes as a pencil of blue light from each of some millions of metallic discharge points across a short air-gap to nickel receivers. Atmospheric air is drawn across this gap by means of an air pump, and in so passing it is partially converted into ozone. The ozonized air is then forced through a stand-pipe, in which it meets a current of water flowing in the opposite direction. The contained bacteria are instantly destroyed by the ozone.

THE FLIGHT OF METEORS.

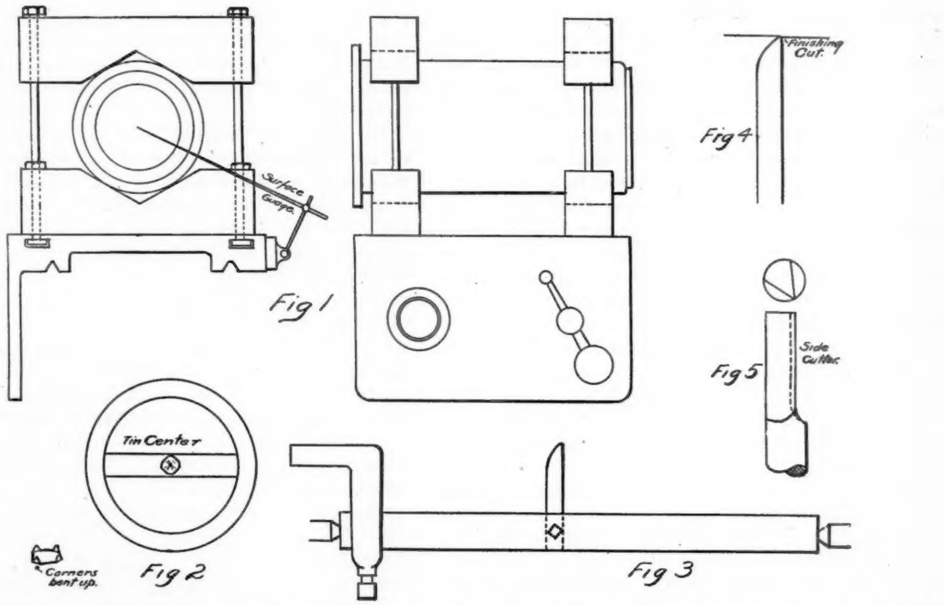
Meteors, before encountering the earth's atmosphere are invisible to us traveling in their own orbits about the sun. Immediately on striking the earth's atmosphere their kinetic energy begins to be changed to heat and at a heighs of 75 to 100 miles they become visible, where the air is more rarified than under the exhausted receiver of an air pump. This rarefaction of the upper air does not, however, save them from the effects of their impact with the atmospheric molecules. It takes only a fraction of a second to consume the smaller meteors. Even if meteors, instead of moving about in space, were without motion and were encountered by the earth in its flight their fate would be similar, for the velocity of the earth in its orbit is at the tremendous speed of 19 miles each second of time, and a meteor coming in contact with the earth's atmosphere would immediately assume a temperature estimated at 600,000 degrees, which would mean total obliteraiton.

THE METAL WORKING LATHE AND ITS USES.

ROBERT GIBSON GRISWOLD.

VI. Boring Cylinders.

The screw-cutting lathe is a machine peculiarly adapted to the boring of cylinders, field castings for motors and dynamos and, in fact, almost any long, cylindrical holes in any piece that can be fastened to the carriage of the lathe. To do this work properly, the piece must be firmly supported and secured to the carriage. Most lathes have a carriage mounted on very long V bearings which give great stability, and these bearings are provided with T slots into which bolts may be fitted for strapping work to the blocking placed on the carriage. Many of the small amateur lathes are not so provided, but with a little thought it is possible to rig up the carriage so that a very respectable job can be done.



Let us consider the case of boring a three inch cylinder for a small gas or steam engine. A block of hard pine or oak is cut to such a shape as will support the cylinder in question at both ends, and for this purpose the V shaped bearing is by far the best, as it will prevent slipping better than a circular seat. In Fig. 1 is shown how these blocks may be secured to the carriage. The bolts *aa* are of such a length as to pass completely through the two blocks, and one end is threaded for the greater portion of the body length. This enables the nut to be screwed down to the lower block, and another nut may be brought to bear against the upper block, using only one bolt in each end.

It is a good scheme in doing this class of work to lay out the carriage full size on a piece of paper, then mark the exact height of the lathe center above the carriage, draw in the section of the cylinder, and then the determination of the best sized block is readily determined. The V should not be too shallow, neither should it be so deep as to cut nearly through the piece. While requiring a little more time, it is a very good thing to tack a piece of sheet copper or brass in the V upon which the piece may rest. This has a two-fold object. It not only prevents the cylinder being driven into the softer wood by the pressure of the clamp above, but it adds greatly to the holding power of the clamping arrangements. The metal, being soft, takes a firm grip on the casting, and it will require a greater force to twist it under the pressure of the tool. This also admits of a deeper cut being taken, although in the case of amateur work it is always advisable to work a little more slowly, take smaller cuts and secure a finely finished job, which is not always possible when the work is hurried.

Having determined about the size of our V blocks, the holes are drilled in the ends slightly larger than the bolt diameter so that they may be shifted to bring the cylinder exactly into line. They are then placed in position and clamped in place. If your lathe is not provided with slots for the reception of the bolt-head, it will pay you to drill four holes for this purpose, tapping them to receive the threaded end of the bolt, which then becomes a stud.

The cylinder is now placed in position and lined up by placing small strips of sheet metal between the bearing points and the block so as to raise the center, if necessary, until it coincides with the center-line of the lathe. To determine the exact position of this center is not very difficult, but it should be done with care, else when the cylinder is bored it may be found that the bore is not perpendicular with the flange or parallel with the sides of the casting. Perhaps the easiest method is to stretch a fine iron wire through the spindle of the lathe, securing it at the farthest end by twisting about a small nail which may be placed across the open end of the spindle. The wire is then passed through the center of the casting and secured to the tail spindle, which is not so easy. A wooden plug may be fitted to the tail-center seat and a small hole drilled in its end through which the wire may pass to be fastened at the small end of the taper. The moving of the spindle outwardly will then draw the wire taut. It is now a simple matter to test the center of the casting with a pair of inside callipers, measuring on all four sides until the wire passes exactly along the center-line of the casting, coinciding therewith. This method is used in a great many cases where it is impossible to get a plane of reference from which to work with a surface gauge. This can, however, be done on a lathe, because the ways are perfectly parallel with the center line. The open ends of the cylinder are provided with sticks driven in so that they pass over the center, and a small piece of tin is fastened to the flat side as shown in Fig. 2, by bending up the four corners of a square and driving into the wood. Then with a pair of hermaphrodite callipers the center is scribed on the tin and located by a very light prick-punch mark.

Now when the casting is ready for setting, a surface gauge is placed on the top of the lathe bed, and the point adjusted so that it exactly coincides with the points of the lathe centers at either end. If the lathe centers are out of line in this respect they should be fixed at once, as accurate work cannot be be done on them. If found correct as to height, the casting is placed on the blocks and set up with "shims" (the small strips of sheet metal spoken of above) until the center marked on the tin coincides exactly with the point of the surface gauge at either end. Yon will find when adjusting this casting that the movement of one end to secure exact coincidence will probably throw the other end out, especially if it has just been accurately set. But this can be nothing more than a "cut and try" method, and the differences must be halved at either end by repeated trials until it is just right.

Then the gauge is set (it is better to have another gauge for this work) so that it may be used from the side of the ways for lining the casting in that direction, as shown in Fig. 1. The upper blocks must be screwed down on the castings very firmly after the setting is about right, and the alignment tested again, as the pressure of the upper block will very likely throw it out somewhat.

Another very simple method, but not always applicable, is to use the points of newly sharpened centers, bringing them into coincidence with the centers marked on the tin. Sometimes these centers cannot be readily seen, but if they can, the method may be used, but it will be found somewhat more difficult to work in the cramped space thus provided between the ends of the casting and head and tail-stock.

Presuming that the casting has been properly set and secured, a boring bar is passed through the middle of the casting and swung on the points of the head and tail centers. (If this bar is perfectly true and straight, it may be used instead of stretching a wire from center, measuring from its periphery to the inside of the bore exactly the same as was directed for the wire.) The cutter is sharpened and placed in position so that it extends exactly the same amount on either side.

For those not familiar with the boring bar, it may be well to give a description of how one may be made. No matter what the work is upon which it is to be used, make it stiff—of as large a diameter as practicable. The bar is supported on the lathe centers, and the pressure of the cut will easily spring it out of line, if not quite stiff. For the 3 in. cylinder above mentioned, a bar not less than 1¼ in. in diameter should be used, and about 18 in. in length. One or more holes may be drilled into it to accommodate the cutters, which may be made of ⅜-in. Stubb's drill rod, or self-hardening steel. A set screw is let into the side to firmly clamp the cutter in position, as shown in Fig. 3.

It may be possible that the novice will experience some difficulty in setting a cutter that cuts on both ends so that it will cut even, and it would, in that case be better to use a shorter cutter, cutting on one side only. The bar will spring some, especially when cutting through the scale. But any irregularity may be corrected by taking smaller cuts afterwards. Never crowd the work nor expect the cutter to do too much. You may move your casting slightly on the blocks, which would cost more time in setting than would be required in running half a dozen small cuts.

Start the first cut so that not more than a good thirty-second of an inch is taken off, and with a feed of not over 1-100 in. to the revolution. The feed, of course, is secured by moving the carriage, and the change gears at the end of the lathe may be so set as to secure almost any feed desired. After the hard scale is cut

through and cleaned out then the feed may be increased to a 64th, and the depth of the cut increased slightly, but if foot power is being used, this will be found quite as much as one wishes to push.

For the finishing cut grind the tool to round point shown in Fig. 4, but do not have it take too broad a cut as it will cause chattering. Measure carefully both ends of the cylinder to make sure that the bore is perfectly cylindrical, as lathes will sometimes bore slightly taper, owing to the centers not being exactly in line. If there are any ports in the cylinder, which is usually the case with a two-cycle engine, it may be necessary to take exceedingly fine cuts while passing these openings, as the pressure of the tool is then relieved and the bar will spring back to its original shape again, causing the tool to cut slightly out of true when it takes hold again on the opposite side of the hole.

While the cylinder may and should be faced while thus set to insure that it will be exactly perpendicular with the bore, it requires great patience and care. The cutter will have to be sharpened on the side so as to make a side tool of it, as shown in Fig. 5, and very light cuts taken while the carriage is fed along by hand. A very good job may be done in this way, however, and it will be truly perpendicular with the cylinder bore. After the cylinder has once been moved or removed from its setting, it will be next to impossible to get it exactly into line again, so one must use great care throughout the work to insure that it does not slip.

REFERENCE BOOK HOLDER.

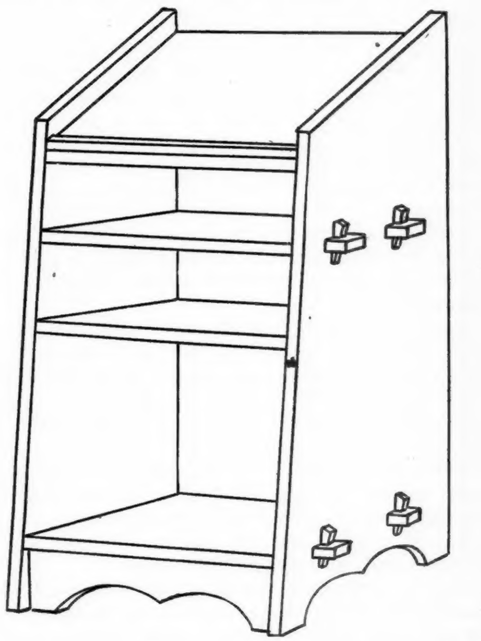
JOHN F. ADAMS.

Such bulky volumes as the dictionary, atlas, and similar books, are frequently to be found in rather inaccessible places, and consequently are not used as often as might be desired, owing to the bother of lifting around to an empty space large enough to receive them. The holder here described is just the right arrangement for making such books available for the uses intended, and readers of this magazine who make frequent use of these books will find the holder will repay the work of making it.

Oak is the wood giving the best effect, but gumwood, cypress or Georgia pine may be used, and when stained with "weathered oak" stain will show the markings of the wood to good advantage. The two side pieces are 36 in. long, 16 in. wide at the bottom, and 12 in. wide at the top, with the top ends cut to the angle for a le ngth 4 in. less than at the back.

The top and middle shelve are 16 in. long or, if the ends are sunk into grooves ¼ in. deep cut in the side, which is recommended for additional strength, the length is 16½ in. These pieces are each 13¼ in. wide, which allows enough for bevelling the front and back edges of the top piece, which is put in with the top side 2 in. below the top of side pieces. At the front edge of this piece a ½ in. square strip is nailed on to make a ledge which serves to prevent the slipping of any book placed thereon. The middle shelf is placed 10 in. below the lower front edge of the top.

The two shelves with projecting ends to receive the wedges are 20½ in. long, the top one 12¾ in. wide and the bottom are 14¾ in. wide; the latter is placed 4 in. above the floor, the upper one 5 in. above the middle shelf previously mentioned. The shelf proper is, of course, the same length as the others, 16 in. with projecting ends 2¼ in. long and 2 in. wide. The ends at the rear are 2½ in. from rear edge of sides; in the upper one; the front ones are 4½ in. and the lower one 5½ in. from the rear ones. The wedges are 2½ in. long, ⅞ in. wide, ¾ in. thick at top and ⅜ in. thick at bottom. After cutting holes in the sides for the ends of the shelves, mark out the location for the holes for the wedges and cut as accurately as possible.



The piece under the lower shelf at the front is 16 in. long and 4 in. wide, with any ornamental curves cut out as desired. It is placed ¼ in. back from the front edge of the lower shelf, and fastened with nails.

In staining furniture in which nail or screw holes have to be puttied up, it is quite necessary that the putty be stained to as deep a color as the wood will be when stained, otherwise wherever putty is used the difference in color will be noticeable. As putty is mixed with oil, an oil stain should be used, the puttying to be done after staining, taking off any conspicuous marks with a cloth wet with the stain. A water stain, if applied after puttying will not take whenever the puttying has been applied, even if no putty remains on the wood; the oil from the putty leaving its impression sufficiently to make unsightly places in the staining.

BOOKS RECEIVED.

WIRELESS TELEGRAPHY, ITS HISTORY, THEORY AND PRACTICE. A. Frederick Collins. 297 pp. 6 x 9 in. 323 Illustrations. $3.00. Supplied by AMATEUR WORK.

This volume may properly be classed as one of the most enterprising, instructive and inspiring treatises of the year.

It is a book written (not compiled) by one who has gone into wireless work with the genuine enthusiasm of the hobbyist; and the personal observations of the writer prove fully as valuable as the descriptive text. The illustrations are appropriate and up-to-date, the references liberal and exact as to title, volume and number.

The first sixty pages cover in detail the theory of Ether, Electric Waves, and the method of propagating waves by means of disruptive discharges. The chapters devoted to oscillations are especially thorough in their treatment, as well as those on capacity, inductance and resistance, with numerous formulæ provided to explain the mathematical values in wireless telegraphy.

In the chapters on Induction Coils and their Operation, the author provides full specifications of coil construction and explains many points pertaining to coil windings, which we never have before seen in print. Especially valuable are the illustrated descriptions of vibrators and interruptors.

The articles on transmission, aerial wires and receptors describe the apparatus, both experimental and practical, in use in America and foreign conntries, and many of the illustrations are directly from photographs made especially for this volume.

All the systems of merit in use in this and other countries, find full treatment with one exception, that of Mr. John Stone Stone of Cambridge, mention of whom is made in paragraphs on multiplex systems and predetermined length of waves. We believe more recognition of this system will appear in later editions when the results of government tests become public, as Mr. Collins has shown every evidence of impartiality throughout his book.

We commend this treatise to both the amateur and the professional. In the reference library it will prove a fitting companion to the able volumes of Vreeland and Lodge.

MACHINE SHOP TOOLS AND METHODS. A. S. Leonard, 562 pp. 9 x 5½ in. 700 Illustrations. Cloth. John Wiley & Sons, New York. Price $4.00. Supplied by AMATEUR WORK.

This book is an enlarged edition, for the first time in book form, of loose leaf instruction papers for the students of Michigan Agricultural College. It is undoubtedly much the best thing which has yet been published upon the subjects included therein, which in general include the tools to be found in a well equipped machine shop and the uses thereof. The opening chapter deals with tools for measuring, followed by hammers, chisels, files, surface plates and scrapers, the vise and accessories, drilling machines, drills, drill-sockets, chucks and accessories, lathes, planers, shapers, slotting machines, milling machines, grinding machines, and the various attachments accompanying each.

Anyone interested in metal working, be he amateur or professional, and especially manual training school teachers, will find this book of great value, and we cordially recommend its purchase.

MODERN INDUSTRIAL PROGRESS. Charles H. Cochrane 647 pp. 9 x 6 in. Numerous illustrations. Cloth. J. B. Lippencott Co., Philadelphia, Pa. Price $3.00 net. Supplied by AMATEUR WORK.

A pleasing feature of this book, which at once attracts the attention of the reader, is the excellence of the illustrations, which are both numerous and well selected to supplement the text. The author has a singular adaptability for his work and keen appreciation of what is necessary to make a book of this general character both interesting and valuable.

It is not possible in the space available to more than indicate the wide range of subjects presented; electricity, in its numerous developments, is given a prominent place, flying machines, vessels of all kinds, implements of warfare, iron from the mine to finished tools of many kinds, and hundreds of other interesting topics, making it virtually a reference book of industrial progress. It will be found of great value to anyone desirous of being informed upon the industries of the day. It would seem especially adapted for public library use, and readers who may not find it convenient to purchase are recommended to propose it to the proper committee of their library.

The extreme length of Mexico is 1600 miles and its greatest width 750 miles. The lofty Rocky Mountain plateau fills it nearly from ocean to ocean leaving but a narrow strip of coast. Its total area is 765,560 square miles, and the population about 14,000,000.

CORRESPONDENCE.

No. 107. TIPTON IND., SEPT. 6, 1905.

How are coherer filings made?

Is there a relay sensitive enough to operate when waves powerful enough to click in the telephone receiver enter upon a wireless receiver made of two carbon blocks and a steel needle laid across the same?

R. A. L.

With a very fine file, prepare equal parts of nickel and silver filings, from U. S. coins, and placing same in an iron spoon bring to a bright heat over a gas burner or live coals. Then bruise the particles, when cold, until they are as fine as possible. Some coherer manufacturers use one part silver and two parts nickel; other use half and half. We have seen coherers with silver and antimony filings in equal parts, also iron and silver. Amateurs will find by experiment the mixture most sensitive and reliable for use with their apparatus.

No relay has been devised to operate when messages are received from any considerable distance on such a device. The telephone receiver and the human ear together form the most sensitive electrical receiver, and when once accustomed to the sounds, operators find the work as easy as reading from the sounder. The advantage of a relay would be in connection with a dot and dash recording device, with which permanent records are made on paper tape.

No. 108. COLUMBUS, OHIO, SEPT. 4, 1905.

Why is the primary core and winding of an induction coil so much longer than the secondary.

I. P. M.

The most active part of a primary is near the ends, and the attraction is from the ends towards the middle, so all the lines of force pass through the secondary winding horizontally as well as vertically, thus giving a stronger saturation to the winding. There is, however, a chance of extending the core too far from the ends of the secondary, thereby increasing the impedence and choking the free action of the primary or saturating current. The design of a primary core and winding depends on the speed of the vibrator, the kind of primary current to be used, and the purpose for which the coil is to be used. For all ordinary purposes we believe the primary core and winding should extend at each end a distance of one-half the full diameter of the end of the secondary. As to the gauge of wire to be used in winding a primary for a small coil of less than 3 in. spark where primary battery is from 10 to 15 volts, amateur coil-makers will find more efficiency may be had with three layers or even four of No. 20 wire than in less layers of coarser wire. The old rule in coil construction was No. 16 wire, two layers. It will prove an interesting experiment for amateurs to wind their primaries with No. 20 or even No. 22 wire and note the results. The batteries will last twice as long, and the secondary spark will show the effect of an increased magnetic field. In every instance this may not prove satisfactory, but it is worth trying.

No. 109. MEDFORD, MASS., SEPT. 7, 1905.

Will a long roll of poultry netting buried in permanently moist soil answer for a wireless telegraph ground?

Where can I buy an experimental coherer, or the parts of one?

Has a 20-ohm sounder any advantage over a 4-ohm sounder for local work? C. O. M.

It will answer very well until it rusts and falls to pieces.

Address any electrical dealer advertising in this paper.

No. The 4-ohm is better, as it uses less battery and makes as clear and loud sounds as any.

No. 110. ROCKLAND, ME., SEPT. 5, 1905.

Can a common magnet from a telephone be used to operate a spark coil? If not, what changes are necessary to make one work to satisfaction? Also, please tell me whether a magneto could be used to charge small storage cells, and what changes should be made in the magnets? H. L. D.

We are in doubt as to the meaning of the first question. Telephones are sometimes fitted with coils having primary and secondary windings, but such coils, even after being fitted with cores, vibrators and condensers, would develop only a very minute spark. The better way, if only a small coil is wanted for experimental purposes, is to make one from specifications to be found in article published in this number. A telephone magneto cannot be used for charging small storage cells, as the current therefrom is alternating, and constant current is necessary for such work.

No. 111. HUNTINGTON, PA., SEPT. 2, 1905.

Will you kindly inform me if the articles on "Amateur Runabout" are to be completed, and when? Would you advise a single cylinder engine of 5 to 7 h. p., or would a double opposed air-cooled engine of the same power be more desirable? I live in a very hilly country, and do not know whether air-cooled or water-cooled would be most efficient in climbing hills. What would you advise? H. G. C.

The articles on the "Amateur Runabout" will be continued as soon as the constructive work on the one being built has advanced enough to provide new matter. The motive power in the one being built has been changed to steam, however, as the writer was desirous of testing steam power in comparison with another of about the same size, using gas engine. Regarding type of engine best adapted for your use, if you are enough of a mechanic to be able to take care of the few additional fixtures required by the two-cylinder engine, it is the best to use in a hilly country. The best one-cylinder engines make slow work of hills, even on low speed, unless the power is large in comparison with weight of car. Air-cooled engines are doing good work in hilly countries, and any tendency to get over-

heated can usually be overcome with a fan run from fly-wheel or shaft.

No. 112. LARSON, WIS. AUG., 30, 1905.

What size of magnet wire for primary and secondary for making a 4-in. spark coil? Also how much of each? Size of bobbin? What size of spark coil for a wireless telegraph 80 rods long? What should be the dimensions for same? How can I drill holes through plate glass? How can circular discs be cut from glass? What is the resistance for 225 ft. of No. 32 magnet wire?

Specifications for coils of various sizes are given elsewhere in this magazine. A ½-in. spark coil would operate for wireless work over a much greater distance than 80 rods, but as that size is easily made at small expense, would recommend it. The drilling and cutting of glass discs is fully described in the April, 1902, number of this magazine, a copy of which will be mailed you for ten cents. The resistance of 225 ft. of No. 32 magnet wire is nearly 27 ohms.

No. 113. MALDEN, MASS., AUG. 26, 1905.

I am about to make a wireless apparatus to operate to a friend's house about 1500 feet away. What size spark-coil would I need for such a line? Do I need a pole? Do the aerial wires have to be of the same height? What would be the best and cheapest receiving apparatus? Would the receiver described in the April '04 number answer? If so, please explain the wiring for that instrument, as I do not fully understand it. How many cells of battery would I need for above? E. W. P.

A coil giving 1-in. spark would probably answer, but a 2-in. spark would be better. Much depends on the nature of the ground over which messages are to be sent. If thickly settled with electric light and other electrical lines frequent, aerial terminals should be at least 75 feet from the ground, which could be secured by mounting a short pole on the roof of the house. The stronger coil would be almost a necessity. The heights and lengths of the aerials should be approximately the same. The receiving apparatus described in the April, '04, number would be a good one for first experiments, and when skill and knowledge of the local requirements had been obtained, the one in the August, '05 number could be made, the latter being much the most sensitive, but more difficult to make and operate. The receiver, or more properly wave detector, is connected in series between the aerial and ground, and the telephone hearing receiver is in shunt with same, being taken from the two center binding posts, as illustrated in the April, '04 number.

A study should be made of the different circuits shown in connection with the various articles on wireless apparatus, as published from time to time. The battery requirements for coil are dependent upon size and wiring of primary circuit, also type of battery used. If dry cells, the primary circuit should have three or four layers of No 18 or 20 wire. If accumulators, the usual winding of two layers of No. 12 to 16 wire is best.

No. 112. SO. FRAMINGHAM, MASS., Aug. 28, '05.

I have made a spark coil for a gas engine, but cannot seem to get a spark from it. Can you give me any idea as to what is the matter with it? The coil is made as follows: Core, 7 in. long, 9-16 diameter, soft iron wire covered with heavy paper (dry.)

The primary is three layers of 103 turns each of No. 18 d. c. c. magnet wire, 1 in. outside diameter. On top of this is wound 1 lb., 15 oz., of No. 26 cotton covered magnet wire, making 203 turns and 30 layers in the length of the coil, which is 5 3-16 in. inside the ends. Between each layer of the secondary is a piece of tissue paper (dry). The outside diameter is 2⅝ in. By dry paper I mean paper that has no coating or preparation on it. C. I. G.

Your description of the coil makes no mention of insulation between primary and secondary winding. The two should be well insulated by a pasteboard tube thoroughly soaked in paraffine or shellac. If coil has such insulation, and gave spark when first tried but no longer does so, the insulation of secondary has broken down, and secondary will have to be rewound. If the coil never has given a spark, or a spark of at least ¼-in. length, there is undoubtedly a break in the primary or secondary winding, probably the latter. Test windings by sending the current from two or three cells of battery through them, and by means of a galvanometer learn if a current flows through windings. If not there is a break and rewinding will be necessary. You also omit to mention vibrator. Has coil been fitted with one? If so, make it vibrate with a small stick, and watch for results from secondary. A simple galvanometer can be made from a cheap compass placed over a few turns of wire on a block of wood.

India furnishes 56 per cent of the world's output of mica, while the United States and Canada produce nearly all of the remainder.

The highest concrete chimney ever built is located at Tacoma, Washington. It is 307 feet high and was designed for a smelter to carry away the deadly fumes developed in the reduction of the ores so that the surrounding vegetation will not be injured or the residents in the vicinity annoyed.

In May, during the progress of some excavations on the estate of Lord Normanteau, near Crowland, Peterborough, Eng., workmen exposed a subterranean forest some ten feet below the surface and about three acres in extent. Some of the trees were in an admirable state of preservation, and one large oak measured fifty-four feet in length. Although buried for unknown ages, the trees were found in such state of preservation that different kinds of wood could easily be determined. A kind of fir tree was most abundant. The surrounding clay contains quantities of remains of lower animal life.

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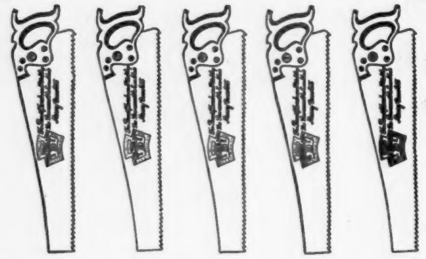

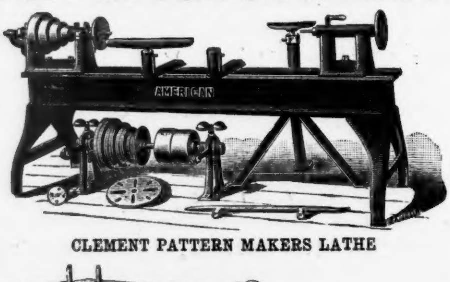
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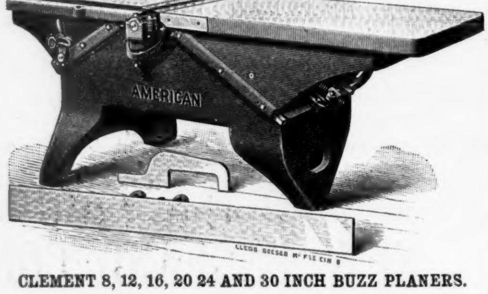
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